Amphipod Parasites of Fishes of Canada

E L Bousfield

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ABSTRACT

BOUSFIELD, E. L. 1987. Amphipod parasites of fishes of Canada. Can. Bull. Fish. Aquat. Sci. 217: 37 p.

Gammaridean amphipod crustaceans, parasitic or semi-parasitic on the external surfaces of fishes of Canadian coastal marine waters, are described and illustrated, and records of those from Canadian Pacific waters are published for the first time. None have been encountered on freshwater or anadromous fishes. Parasitic amphipods encountered include members of the family Lysianassidae (*Opisa eschrichti* (Krøyer), *O. tridentata* Hurley, and ***O. odontochela***, new species), family Pardaliscidae (*Rhynohalicella halona* (J.L. Barnard)), and family Lafystiidae (three new species of *Lafystius*: ***L. morhuanus***, ***L. acuminatus***, and ***L. frameae***; ***Paralafystius mcallisteri***, new genus, new species; and ***Protolafystius madillae***, new genus, new species). These amphipods frequently occur around the mouth fringes, on the gills, and on the skin surface, often under the pectoral and pelvic fins and around surface wounds, of chiefly benthic, slow-moving and "ambush-predator" types of fishes, such as cod (*Gadus*), sculpins (*Myoxocephalus*), goosefish (*Lophius*), greenling (*Hexagrammos*), rockfishes (*Sebastes*), dogfish (*Squalus*), and skates (*Raja*). Although limited, the material examined in this and previous studies suggests the possibility of host specificity at both genus and species levels in some amphipod groups. Several (perhaps many) new genera and species within the four families mentioned in this study may yet be discovered in a much broader sampling of the very rich marine fish fauna of Canadian waters.

RÉSUMÉ

BOUSFIELD, E. L. 1987. Amphipod parasites of fishes of Canada. Can. Bull. Fish. Aquat. Sci. 217: 37 p.

L'auteur présente une description illustrée des crustacés amphipodes du sous-ordre Gammaridea vivant à l'état de parasite ou de semi-parasite sur le corps de poissons fréquentant les eaux salées du littoral canadien. Il signale aussi pour la première fois la présence des espèces retrouvées dans les eaux canadiennes du Pacifique; aucune de ces espèces n'était présente chez les poissons anadromes et dulçaquicoles. Les amphipodes parasites signalés apartiennent à la famille Lysianassidae (*Opisa eschrichti* (Krøyer), *O. tridentata* Hurley et ***O. odontochela***, nouvelle espèce), la famille Pardaliscidae (*Rhynohalicella halona* (J. L. Barnard)) et la famille Lafystiidae (trois nouvelles espèces du genre *Lafystius*: ***L. morhuanus***, ***L. acuminatus*** et ***L. frameae***; ***Paralafystius mcallisteri***, nouveau genre et nouvelle espèce; et ***Protolafystius madillae***, nouveau genre et nouvelle espèce). On retrouve souvent ces amphipodes autour de la bouche, sur les ouïes et la peau, sous les nageoires pectorales et pelviennes et près de blessures chez les poissons qui, en général, fréquentent le milieu benthique, se déplacent lentement et se tiennent en embuscade pour capturer leurs proies comme les morues (*Gadus*), les chabots (*Myoxocephalus*), la baudroie (*Lophius*), les lingues (*Hexagrammos*), les scorpènes (*Sebastes*), l'aiguillat (*Squalus*) et les raies (*Raja*). Quoique limité, le matériel examiné dans le cadre de la présente étude et d'études antérieures porte à croire que certains genres et espèces d'amphipodes peuvent montrer une spécificité parasitaire. Il est possible qu'on découvre plusieurs (peut-être de nombreux) nouveaux genres et espèces appartenant aux quatre familles susmentionnées à l'examen d'un échantillon beaucoup plus vaste de la riche faune marine des eaux canadiennes.

INTRODUCTION

Amphipods are small to medium-sized malacostracan crustaceans characterized by a laterally compressed body, uniramous thoracic walking legs, sessile eyes, and lack of a carapace. Diagnostically, the abdominal appendages are grouped in three anterior pairs of pleopods and three posterior pairs of uropods, in contrast to the 5 : 1 groupings of isopods, decapods and all other malacostracans. Of approximately 6000 described amphipod species, one family, Talitridae, contains terrestrial and semiterrestrial forms. Most others are free-living on the bottom and free-swimming in the water column of marine, estuarine, and freshwater habitats, from the tide marks to the deepest ocean trenches, and from the tropics to the high arctic (Bousfield 1982). They feed on organic detritus, planktonic and benthic plant and animal matter. However, some groups of amphipods have become intimately associated with other organisms, either as commensals, inquilines, micropredators or parasites, both obligate and facultative.

Amphipods are parasitoid or parasitic on the external surfaces of a wide variety of animals, both vertebrate and invertebrate. Some amphipods even utilize plant hosts. Species of *Najna*, for example, form galls on the stipes of kelps, and *Ampithoe humeralis* stitches up the blades of giant kelp to form its domiciles (Bousfield 1982). Included amongst amphipods with invertebrate hosts are pelagic Hyperiidea, which are mainly parasitoid on medusae and salps (Shih 1982); benthic Lysianassidae on tunicates, anemones, and other jelly-like colonial animals (Vader 1983), Liljeborgiidae in tubes of marine worms and crustaceans (Bousfield 1973, 1982), and Colomastigidae and Leucothoidae in the respiratory cavities of sponges and tunicates (Bousfield 1982). Amphipods parasitize most vertebrate groups in the marine environment. The louse-like Cyamidae parasitize baleen, sperm, and beaked whales, and the talitroidean *Hyachelia* lives in the buccal cavity of marine turtles (Bousfield 1982). Aquatic birds seem to be the exception, although a few species may provide temporary attachment for "hitch-hiking" (dispersing) amphipods (e.g., ducks, for *Gammarus lacustris* and *Hyalella azteca*).

A few groups of amphipods, not all closely related, have become specialized as external parasites of fishes (see Dolfuss 1953). Some may be facultative rather than obligate parasites, and may live freely on the bottom or in the water column during some or most of their lives. Some amphipod parasites on fishes may be termed "hitch-hikers", clinging to various skin surfaces or gills of the host by means of clamp-like gnathopods (e.g., in Trischizostomatidae, *Opisa* group of lysianassids, the pardaliscid *Rhynohalicella*) or prehensile peraeopods (in Lafystiidae) (Bousfield 1982). Species of lysianassoidean and pardaliscoidean parasitic groups may swim sporadically in the water column, presumably both for the purpose of mating, or at least mate-finding, and for seeking out new fish hosts.

Despite more than a century of fish management in Canadian waters, very little is known of the biology and life history of amphipods parasitic on fishes here. Thus, a recent and comprehensive synopsis of parasites of Canadian fishes (Margolis and Arthur 1979) did not include even a single species of amphipod! Parasitic amphipods apparently do not occur on freshwater or anadromous fishes, and are usually found on slow-moving, slow-growing benthic sharks and bony fishes of cold or deep waters (Vader and Romppainen 1987). Many of these fishes (e.g., rockfish (*Sebastes*), sculpins (*Myoxocephalus* and *Cottus* spp.), goosefishes (*Lophius* spp.), and flatfishes (Pleuronectidae)) may be described as "ambush predators". The morphological modifications of the mouthparts of the parasitic amphipods and the occurrence of these animals around the mouth fringes, opercular plates, gills, pectoral fins, anal opening, and surface wounds of the fishes suggest that the amphipods are actively feeding on surface mucus, skin tissues, body wastes and discarded food items of the host.

The first account of an amphipod fish parasite in Canadian waters was that of Stebbing (1888), who partly figured a specimen of "*Lafystius sturionis*" from a *Cottus* taken off Halifax, Nova Scotia. Since that time, relatively few amphipod fish parasites, mainly of the genus *Opisa*, have been recorded in Canadian Atlantic and Arctic waters. No parasitic

TABLE 1. Amphipod parasites of Canadian fishes.

Amphipod species	Region	Recorded fish host	Reference
I. LYSIANASSIDAE			
Opisa eschrichti Kr.	European Atlantic	*Gadus callarias*	G. O. Sars (1895)
	N. American Atlantic	*Melanogrammus aeglefinus*	K. Stephensen (1923)
		Hippoglossus hippoglossus	Vader and Romppainen (1987)
O. tridentata Hurley	N. American Pacific	*Sebastes ruberrimus*	Present study
		S. maliger	Present study
		S. mystinus	Present study
		Hexagrammos decagrammus	Present study
		Squalus acanthias	Present study
O. odontochela, n. sp.	N. American Pacific	*S. maliger*	Present study
Podoprionella norvegica Sars	European Atlantic	demersal fishes	Vader and Romppainen (1987)
Normanion quadrimanus Bate	European Atlantic	*M. aeglefinus*	
		Lophius piscatorius	
		Etmopterus spinax	G. O. Sars (1895)
II. TRISCHIZOSTOMATIDAE			
Trischizostoma raschi Boeck	North Atlantic	*Etmopterus spinax*	G. O. Sars (1895)
			Vader and Romppainen (1987)
Guerina nicaensis Costa	Central Mediterranean	*Chlorophthalmus agassizi*	Sexton (1908)
III. PARDALISCIDAE			
Rhynohalicella halona Barnard	N. American Pacific	Unknown	Barnard (1971)
			Present study
IV. LAFYSTIIDAE			
Lafystius sturionis Krøyer	N. Atlantic	*Acipenser sturio*	Krøyer (1842)
		Gadus callarias	G. O. Sars (1895)
		M. aeglefinus	K. Stephensen (1923)
		H. hippoglossus	Vader and Romppainen (1987)
		L. piscatorius	Vader and Romppainen (1987)
		Raja batis	Vader and Romppainen (1987)
L. morhuanus, n. sp.	N. American Atlantic	*G. morhua*	Wise(1958), Bousfield(1973)
		M. aeglefinus	Appy and Burt (1982), Present study
		Macrozoarces americanus	Present study
		Myoxocephalus scorpius	Present study
		Raja erinacea	Present study
		R. radiata	Present study
		Malacoraja senta	Present study
		Cottus sp.	Stebbing (1888)
L. acuminatus, n. sp.	N. American Atlantic	Unknown	Present study
L. frameae, n. sp.	N. American Atlantic	Unknown	Present study
Lafystius sp. Holmes	Cape Cod (N.Am.Atl.)	*Lophius americanus*	Holmes (1905)
"*L. sturionis*"	California (N.Am.Pac.)	*Sebastes paucispinis*	Jensen et al. (1982)
"*Lafystius*" sp.	Puget Sound (N.Am.Pac.)	Unknown	Park (1961)
Paralafystius mcallisteri, n. g., n. sp.	S.E. Alaska (N.Am.Pac.)	*Sebastes* sp.	Present study
Protolafystius madillae, n. g., n. sp.	N. Am. Pac.	*Parophrys vetulus*	Present study

amphipods have yet been recorded from the Pacific coast of Canada, although species of *Lafystius* and *Opisa* have been recorded from California, Washington, and Alaska (e.g., Jensen et al. 1982; Park 1961; Scheffer 1959).

In the past, host specificity of amphipod fish parasites was assumed to be low (Vader and Romppainen 1987). For example, careful examination of numerous specimens obtained from a moderately broad range of fish hosts, from bottom samples, and from fish stomach contents, revealed only three distinct species of *Opisa*, one from the Atlantic and two from the Pacific coastal marine regions (Table 1).[1] Such evidence indicates that some of these species may be facultative, rather than obligate, parasites. In that case, one would not expect a high degree of host specificity. However, members of the large, powerfully swimming Trischizostomatidae have been found to be relatively host specific, sometimes occurring in younger stages on benthic invertebrates and, as adults, on a narrow range of fish hosts (Sexton 1908; Vader and Romppainen 1987). The black dogfish (*Etmopterus spinax*) is known to host *Trischizostoma* in northern European waters and also occurs off the Canadian Atlantic coast, so the parasite could be expected to be found here as well. However, this is not yet the case, possibly because the black dogfish and other sharks of the family Squalidae tend to occur in deep waters of the shelf, are not commercially important, and thus are seldom captured by Canadian fishermen.

On the other hand, morphological diversity amongst parasitic members of the family Lafystiidae is proving more diverse, at both genus and species levels. Although "*Lafystius sturionis* Kr." has been recorded from nearly a dozen fish species across the holarctic region, several species of amphipods actually may have been involved, each on specific hosts. Re-examination of all such material thus appears warranted.

The purpose of the present work is to update knowledge of those amphipods that live parasitically or semi-parasitically on fishes of Canadian and contiguous marine regions, based on re-analysis of the literature, as well as on examination of new material from recent regional expeditions (see Bousfield and Laubitz 1972; Bousfield and Jarrett 1981). In particular, the systematics and host specificity of amphipod parasites, both at the species and the genus levels, are investigated. If some of the genera and many of the species prove to be obligate parasites and host specific, and reflect to some degree the phylogeny of the host, one might expect that a very diverse assemblage of parasitic amphipods should be discovered on the rich but little studied fish fauna of Canadian marine regions. It is hoped that the present study may serve to stimulate further investigations and provide a framework upon which subsequent taxonomic groupings may be based.

SYSTEMATICS

Key to Families of Amphipods Parasitic on Fishes of Canada

1 Body flattened dorsoventrally, often broader than deep (louselike); rostrum large, forming flat, apically truncated plate over base of antennae; antenna 1 slightly larger or longer than antenna 2; accessory flagellum lacking; coxa 4 deepest, acute below; uropod 3, outer ramus the shorter, 1-segmented, tip rounded ..... Lafystiidae (p. 18)

Body slender, deeper than broad (torpedo-shaped in dorsal view); rostrum very short or, if large, broadly acute; antenna 1 shorter than antenna 2, often markedly so (esp. in males); accessory flagellum present; coxa 4 not conspicuously deeper than 3, rounded below; uropod 3, outer ramus the longer, usually 2-segmented, tip acute 2

[1]A further new species of *Opisa* has been found in the nares of *Sebastes chlorostrictus* from coastal waters of California (Bousfield, unpublished data).

2 Eyes usually large, multi-faceted, pigmented; gnathopods dissimilar in form and size, gnathopod 2 usually mitten-like, dactyl minute; coxae large, deep; coxa 3 usually distinctly deeper than broad; urosome segments usually smooth dorsally; coxal gills on peraeon segments 4–6 pleated cross-wise 3

Eyes usually lacking, or weakly pigmented; gnathopods generally similar in form and size, gnathopod 2 usually strongly dactylate; coxae small, barely overlapping; coxa 3 broader than deep; urosome segments usually with mid-dorsal process; coxal gills all sac-like or plate-like, simple ..... Pardaliscidae (p.15)

3 Rostrum prominent, extending beyond antennal segment 1; coxal plate 2 distinctly largest, deepest; telson plate-like, entire; brood plates (female) moderately broad, margins with many setae ..... Trischizostomatidae (p.14)

Rostrum small or lacking; coxal plate 4 usually largest and deepest; telson usually bilobate; brood plates slender, marginal setae few, distal .... Lysianassidae (p. 4)

Family LYSIANASSIDAE

Lysianassinae Hurley, 1963 (*partim*)
Opisa group
Acidostoma group Sars 1895 (p. 32–38, 674–675)
Barnard 1969 (p. 298–299 (Key C))

A distinctive subgrouping of genera within Lysianassinae Hurley, 1963 containing members associated with fishes in a parasitic or semi-parasitic mode. Included in this group are the boreal (cold-temperate) and subarctic genera *Opisa* Boeck, *Cheirimedon* Stebbing, *Normanion* Bonnier, and *Podoprionella* Sars, possibly the warm-temperate *Podoprion* Chevreux (E. Atlantic), and the Antarctic *Podoprionides* Walker. This group has not yet been recognized formally at the suprageneric level. It seems closely related to *Acidostoma* Liljeborg, in which the mouthparts are also much modified (and include a proximally inserted mandibular palp) and grouped in a conical bundle beneath the head. The group is further characterised by (i) an enlarged, strongly subchelate or cheliform (but small-wristed) gnathopod 1 (by means of which, presumably, the animal attaches temporarily to the host), (ii) a very reduced (or even lacking) mandibular molar, (iii) a broadened outer plate but reduced palp of the maxilliped, and (iv) generally small body size.

Within this subgroup, *Opisa* and *Cheirimedon* exhibit relatively primitive morphological features such as deep coxal plates, bilobate telson, small modification or reduction of mandibular and maxillipedal palps, and distinctly 2-segmented outer ramus of uropod 3, the inner margin of which (in *Opisa*) is usually plumose-setose. Moreover, *Opisa* exhibits strong sexual dimorphism in retaining a pelagic terminal male form, in which (i) the eyes are larger than in the female, (ii) the callynophore of antenna 1 is more strongly developed and (iii) the flagellum is calceolate, (iv) the flagellum of antenna 2 is elongate and the segments calceolate, and (v) the pleopods and tail fan tend to be more strongly developed. To date the only members of this group that have been recorded from the Canadian marine region are species of *Opisa*.

Key to subarctic and boreal genera of the *Opisa* group

1 Peraeopod 5, coxal plate usually deeper than the length of the basis (segment 2); uropod 3, outer ramus distinctly 2-segmented; telson markedly bilobate 2

Peraeopod 5, coxal plate shallow, less deep than the length of the basis; uropod 3, outer ramus appearing 1-segmented (outer segment fused to inner); telson lobes fused apically to form an entire plate 3

2 Gnathopod 1 appearing deeply cheliform, tip of dactyl closing on a slender, thumb-like process from the posterior angle of the concave palm; uropod 3, rami with some setose margins; maxilliped palp projecting little (less than 2 segments) beyond outer plate ..... *Opisa* (p. 5)

Gnathopod 1 appearing triangular-subchelate, dactyl closely fitting convex palm; uropod 3, margins of rami lacking setae; maxillipedal palp projecting distinctly (outer 2 segments) beyond outer plate ..... *Cheirimedon* Stebbing

3 Gnathopod 2 subchelate, palm convex; uropod 3, peduncle longer than rami; mandibular palp, segment 3 slender, elongate; maxilla 1, inner plate present ..... *Normanion* Bonnier

Gnathopod 2 cheliform, palm concave; uropod 3 normal, rami exceeding peduncle in length; mandibular palp, segment 3 very short; maxilla 1, inner plate lacking or vestigial ..... *Podoprionella* Sars

Genus *Opisa* Boeck, 1876

Opisa Sars 1895 (p. 36)
Opisa Stebbing 1906 (p. 20)
Opisa Barnard 1969 (p. 353)

DIAGNOSIS: Body and coxal plates deep; sexually dimorphic, with pelagic terminal male form. Coxa 1 shortest, mostly masked by coxa 2. Urosome dorsally smooth. Anterior head lobe pronounced. Eyes large, subrectangular, multi-faceted, strongly pigmented. Antenna 1, callynophore well developed, especially in the male; flagellum short, calceolate in the male; antenna 2, flagellum short in female, elongate and calceolate in male. Upper lip, epistome normal; mandible, molar vestigial, blade row long, left lacinia reduced to a single spike; palp segment 1 long, unarmed, inserted proximal to molar. Maxilla 1, inner plate with few apical setae, apex of outer plate with 6 strong outer, and 5 weak inner pectinate spine–teeth. Maxilla 2, plates subequal, setae apical. Maxilliped, outer plate broad, cutting edge weakly toothed proximally, palp short, dactyl exceeding outer plate.

Gnathopod 1 powerfully cheliform, tip of strongly curved dactyl meeting apex of slender tooth-like process of postero-distal angle of palm; segments 3–5 short, smooth behind. Gnathopod 2 slender, segments 3 and 5 elongate, 6 (propod) and 7 (dactyl) micro-subchelate (not chelate or parachelate). Peraeopods 3 and 4 slender, lightly setose behind, dactyls slender. Peraeopods 5–7 basically homopodous, bases of 5 and 6 narrowing proximally, coxa 5 usually deeper than length of basis of P5, dactyls slender.

Abdominal side plates 1–3 deep, hind corners not produced. Uropods 1 and 2, rami narrowly lanceolate, weakly or not sexually dimorphic. Uropod 3, rami lanceolate, longer than peduncle, outer ramus distinctly 2-segmented, inner margins of rami strongly fringed with plumose setae in the male, weakly in the female. Telson deeply bilobate, apices with notch and spine, lobes relatively longer in male.

Coxal gills 5–7 weakly pleated, each with basal accessory lobe. Brood plates slender, elongate.

Type species: *Opisa eschrichti* Krøyer, 1842.
Other species: *O. tridentata* Hurley, 1963.
O. odontochela, new species.

Key to species of *Opisa* in Canadian waters

1 Coxal plate 5 deep, depth greater than length of basis; telson lobes always marginally spinose; posterior margin of abdominal side plate 3 smooth; maxilliped palp exceeding outer plate by more than dactyl 2

Coxal plate 5 wider than deep, depth less than length of basis; telson lobes usually lacking dorso-lateral spines; posterior margin of abdominal side plate 3 evenly crenulated or denticulated; maxilliped palp exceeding outer plate by length of dactyl only ..... *O. tridentata* Hurley (p. 8)

2 Gnathopod 1, dactyl large, strongly arched, smooth behind; palm of propod smoothly concave, with few setae only; uropods 1 and 2, rami evenly tapering and normally spinose; uropod 3, inner margins of rami lined with plumose setae ..... *O. eschrichti* (Krøyer) (p. 6)

Gnathopod 1, dactyl short, nearly straight, evenly dentate behind; palm of propod straight, lined with close-set "palisade" spines; uropods 1 & 2, rami each with medio-distal notch and stout spine; uropod 3, margins of rami bare (or nearly so) ..... *O. odontochela*, n.sp.(p.11)

Opisa eschrichti (Krøyer, 1842)
(Figure 1)

O. eschrichti Stebbing 1906 (p. 20)
O. eschrichti Sars 1895 (p. 36–37, Plate 14.1)
O. eschrichti Shoemaker 1930a (p. 6), 1930b (p.12)
O. eschrichti Dunbar 1954 (p. 710–711)
O. eschrichti Brunel 1961 (p. ?), 1970 (p. 35)
O. eschrichti Ledoyer 1975a (p. 108), 1975b (app., tab.2)

MATERIAL EXAMINED:

ST. LAWRENCE ESTUARY (collections of Dr. Pierre Brunel, GIROQ Cat. No. 72A):
Miscou Bank, Chaleur Bay, Stn HEC28 (48°11′15″N, 64°17′15″W), bottom samples 1–10, 48 m, 25.08.53, 1 ovigerous ♀ (8.0 mm) (H.E. Corbeil, coll.). Entrance to Chaleur Bay, Stn HP112-69L-2991 (48°18′07″N, 64°21′22″W), 110 m, benthic sled, 2.09.69, 1 ♂ adult (L. Poirier & D. Granger, coll.). North shore lower St. Lawrence estuary off Cape Colombier, Stn HP487-70K-331 (48°45′24″N, 68°49′36″W), 120 m, clayey silt, Macer-GIROQ suprabenthic sled, 28.08.70, 1 ovigerous ♀ (slide mount) (P. Brunel & students, coll.). North shore lower St. Lawrence estuary off Rimouski, Quebec, Stn B432-71J-106D (48°33′30″N, 68°49′36″W), 64 m, anchor dredge on hard ground, 30.06.71, 1 ♂ adult (slide mount) (P. Brunel & students, coll.).

DIAGNOSIS: The following diagnosis is based on material from the Gulf of St. Lawrence (above) which tends to differ in a number of small features from topotype material described and illustrated by Sars (1895) from the coast of Norway.

Eye subrectangular, 5–6 facets wide. Antenna 1, flagellar distal segments with about 3 calceoli in both sexes. Antenna 2 distinctly longer than 1 in female, flagellum at least 10-segmented. Mandibular palp, segment 2 with a distal row of close-set, longish, simple setae; segment 3, inner margin with 12–15 stiff simple setae, the longest at the apex. Maxilliped, outer plate a little broader than palp, exceeded by dactyl and half of segment 3 of

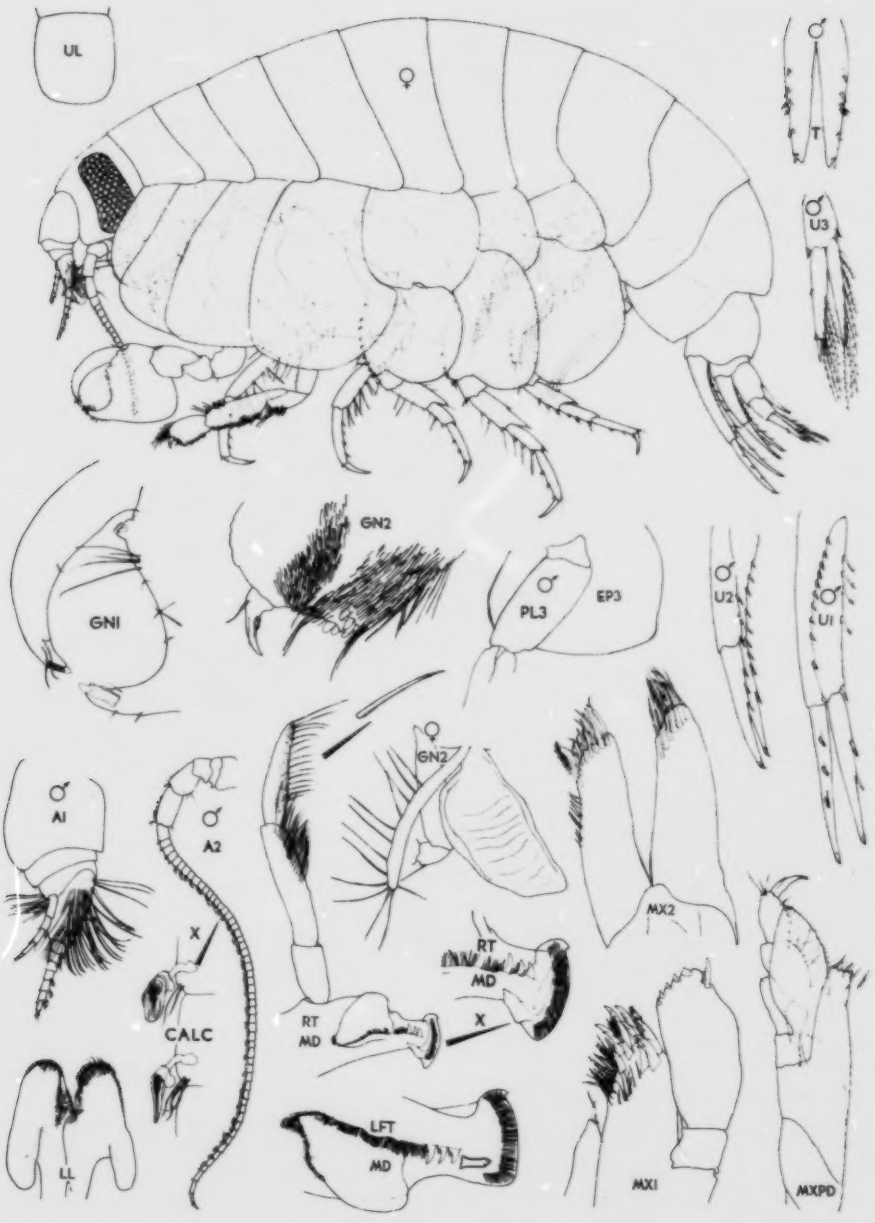

FIG. 1. *Opisa eschrichti* Kr. St. Lawrence Estuary, off C. Columbier. 120 m sled. ♀ ov. 9.0 mm. Off Rimouski, Que. 64 m dredge. ♂ 7.8 mm. (*See p. 37 for legend for figures.*)

palp, inner plate with 3 apical spine–teeth. Coxa 1 relatively short, distally shallower than coxa 2. Gnathopod 1, thumb-like process from posterodistal angle of palm with 2 subapical spines. Gnathopod 2, palm of propod oblique, posterodistal angle with 5–6 blunt spines. Coxa 4, posterior excavation extending little more than half depth of plate. Coxa 5 only slightly deeper than length of basis of peraeopod 5. Abdominal side plate 3, hind corner nearly square. Uropod 1 (male), outer margin of peduncle armed with about 12 short spines, inner margin proximally with 4 longer spines. Uropod 3, rami narrowly lanceolate, inner margins plumose–setose in both male and female. Telson lobes armed dorsolaterally with 3–4 short spines. Coxal gills large, basal lobes on peraeopods 5–7 not developed. In other respects, the North American material resembles closely the European material illustrated by Sars (above).

HOST SPECIES: *Opisa eschrichti* has been recorded from the skin of European cod (*Gadus callarias*), Atlantic cod (*G. morhua*), and from haddock (*Melanogrammus aeglefinus*). It has also been taken as a free-swimmer in bottom dredges and in plankton hauls.

DISTRIBUTION: North Atlantic, western Europe to the Bay of Biscay north to northern Norway and the White Sea and westwards to Iceland (Stephensen 1944), northwestern Greenland (Just 1980), and the Canadian subarctic, including Ungava Bay in the north (Dunbar 1954), and southwards to the St. Lawrence Gulf and estuary, Nova Scotia, Bay of Fundy, Gulf of Maine, and Cape Cod (Vineyard Sound) (Shoemaker 1930a, b). Austin (1985) lists records from British Columbia to central California that he suggests may be of *O. tridentata*.

LIFE CYCLE: Unknown; probably one brood per year.

REMARKS: Morphological differences between European and North American material noted here may prove to be of significance at the species or subspecies level. To clarify the taxonomic situation, a fresh series of material from several hosts from both regions should be carefully examined.

Opisa tridentata Hurley, 1963
(Figure 2)

Opisa tridentata Hurley, 1963 (p. 26–30, Fig. 4 and 5)
O. tridentata Austin 1985 (p. 601)
Opisa sp. ? Scheffer 1959 (p. 377)
Opisa sp. ? Lie 1968 (p. 357)

MATERIAL EXAMINED:

SOUTHEAST ALASKA (see Bousfield and McAllister 1962 for details):

Bradshaw Cove, Chichagof I., Stn A-24 (Map stn 29), *Sebastes mystinus* stomach, 9.06.61, 1 ♀ imm. (4.3 mm) (NMNS Cat. No. NMC-C-1986-976). Biorka Channel, near Tava I., Sitka Sound, Stn A-169 (Map stn 197) 54 m, *Sebastes maliger* base of tail, 24.07.61, 1 ovigerous ♀ (6 eggs) (7.3 mm) (NMNS Cat. No. NMC-C-1986-979). Puffin Bay, Baranof I., Stn A-170 (Map stn 198), 73 m, gill net, *Sebastes maliger* skin and gills, 24-25.07.61, 1 ovigerous ♀ (1 with 10 eggs) (6.4 mm) (slide mount), 3 ♀ ♀ (br. II stage, 4.8–5.2 mm), 1 ♂ adult (6.4 mm) (slide mount), 1 ♂ penult. (6.2 mm) (slide mount), 1 ♂ antepenult. (4.2 mm, 4.3 mm), 2 imm. (4.0, 4.2 mm) (NMNS Cat. No. NMC-C-1986-977). East of Losa I., west of Heceta I., Stn A-173 (Map stn 201) 27–67 m, *Sebastes ruberrimus*, 25.07.61, 2 ovigerous ♀ ♀ (4 & 5 eggs), 1 ♂ penult. (NMNS Cat. No. NMC-C-1986-978). Dewey

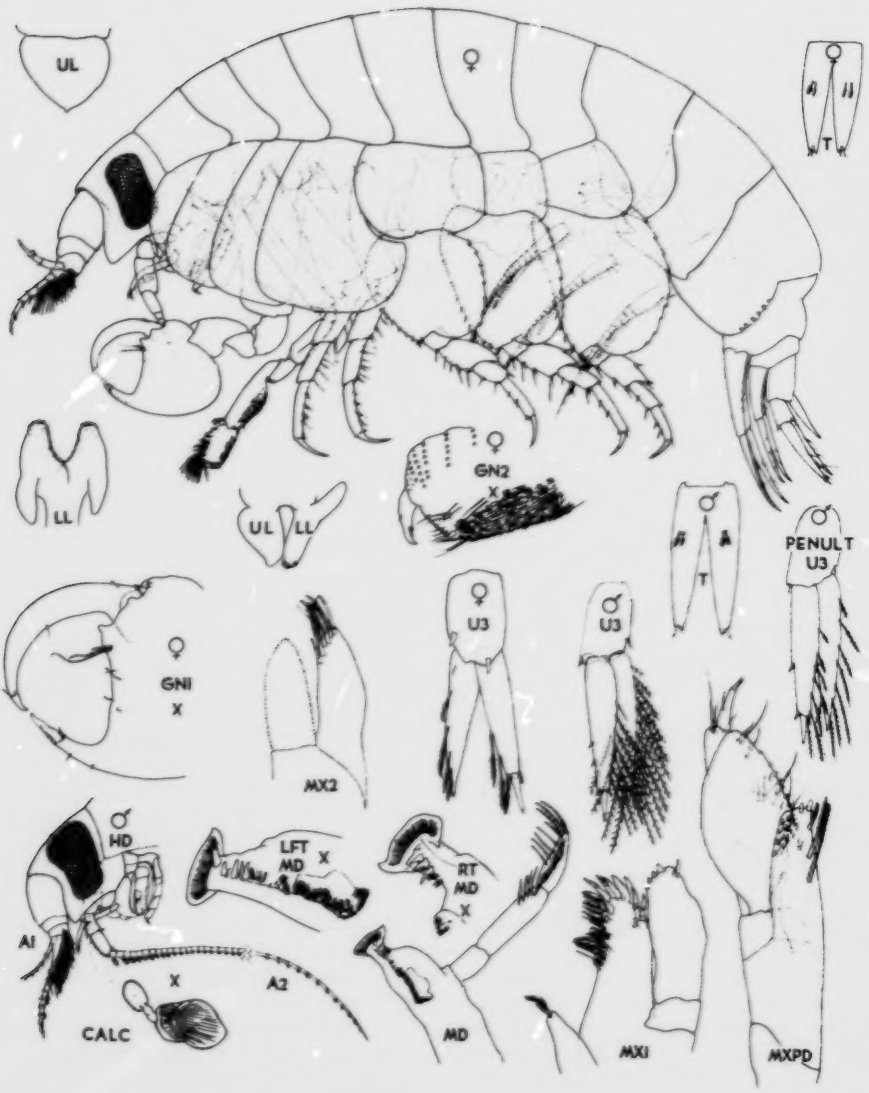

FIG. 2. *Opisa tridentata* Hurley var. Hecate Strait, Q.C.I., B.C. from gills of dogshark, 1977 — ♀ ov. 8 mm. Barnof Is., S.E. Alaska, 1961 — ♂ 7 mm. (*See p. 37 for legend for figures.*)

Rocks, northwest of Marsh Point, Prince of Wales I., Stn A-179 (Map stn 207) 37–55 m, *S. ruberrimus* surface, 26.07.61, 1 ovigerous ♀ (7 eggs) (7.0 mm) (NMS Cat. No. NMC-C-1986-980).

BRITISH COLUMBIA:

Central region (see Bousfield 1968 for details):

Open Bight, mouth of Rivers Inlet, ELB Stn H37, 50–70 m, dredge, 22.07.64, 1 ovigerous ♀ (7 eggs), 1 ♂ penult. (6.0 mm) (NMNS Cat. No. NMC-C-1986-980). Safety Cove, Calvert I., ELB Stn H36, 25–75 m, dredge, 22.07.64, 1 ♂ adult (7.0 mm) (NMNS Cat. No. NMC-C-1986-982). Chapple Inlet, inside Holler Rock, ELB Stn H27, 65 m, dredge, 19.07.64, 1 imm. (NMNS Cat. No. NMC-C-1986-983).

Northern region (unpublished, 1985 material of Patrick Shaw):

Hecate Strait, Queen Charlotte Islands, Stn PR H85-1-1 Stn 9, 2 ♂♂ adults (6.5 mm); Stn PR 228 H85-1-1 Stn 12, 1 ♀ adult (?), 1 ♂ penult. (head regions only); Stn PR H85-1-17 Stn 37, 1 ovigerous ♀ (4 eggs) (6.7 mm). McCauley Pt., Hecate Strait, Dobrocky Seatech Stn W3-A, 49 m, dredge, 26.08.76, 1 ♂ antepenult. (5.5 mm) (G. W. O'Connell, coll.) (D. S. Cat. No. 77-5051, NMNS Cat. No. NMC-C-1986-989). Princess Royal Channel, C.A.I.C. Stn C sample 51-B-16 (53°00′15″N, 128°30′05″W), 152 m, Peterson grab (1.6 m^2), 04.04.73, 1 ovig. ♀ (coll. C. D. Levings) (NMNS Cat. No. NMC-C-1986-988).

Vancouver Is. and Southern region (see Bousfield and Jarrett 1981 for details):

Koprino Harbour, Quatsino Sound, N. Vancouver I., ELB Stn P26, 11–15 m, dredge, 14.08.75, 1 ♂ antepenult. (4.8 mm) (NMNS Cat. No. NMC-C-1986-984). Strait of Georgia off Burrard Inlet, Stn B4 (49°09′N, 123°16′W), dredge, mud, 01.09.77, 1 penult. ♂ (5.4 mm) (C. Levings, coll.) (NMNS Cat. No. NMN-C-1986-985, slide mount). Burrard Inlet, ELB Stn P6, 146 m, dredge, 3.11.77, 1 ♀ (br. I stage, 5.3 mm) (NMNS Cat. No. NMC-C-1986-985). Nanoose Harbour, Vancouver I. (49°N, 125°W), 5.06.31, 1 ♂ adult (7.2 mm) (J. L. Hart, coll.) (NMNS Cat. No. NMC-C-1986-987, slide mount).

Southern region (material of H. Arai, collected by M. J. Kennedy in 1979, from gills and fins of *Squalus acanthias* L.):

Stn GLW-71-6-E3, 1 adult ♂ (8.0 mm), 1 ♀ (br. II stage, 7.0 mm), 1 imm., 4 juv.; Stn GLW-71-8-E2, 1 ovigerous ♀ (8.0 mm), 1 ♂ penult. (7.5 mm); Stn GLW-71-9-E2, 2 ovigerous ♀♀ (6–9 eggs; 6.8 mm), 1 ♀ (br. I stage, 6.7 mm), 3 juv.; Stn GLW-71-10-E2, 1 ♀ imm., 2 juv.; Stn GLW-71-10-E3, 1 ovigerous ♀ (5 eggs; 7.2 mm), 1 ovigerous ♀ (9.0 mm) (slide mount), 1 ♂ antepenult. (8.2 mm) (slide mount), 1 ♀ subad. (6.0 mm), 1 juv. (2.0 mm); Stn GLW-71-12-E3, 1 ovigerous ♀ (3 eggs; 7.2 mm), 1 juv.

DIAGNOSIS: The following diagnostic features are based on material from British Columbia and Alaska (above). Some material from northern B.C. and Alaska differs in the more numerous dentations on the posterior margin of abdominal side plate 3 (4–6, versus 3–4 in outer B.C. and southern and Californian material (cf. Hurley 1963), and in the somewhat larger size.

Head, anterior lobe prominent, subacute. Rostrum small but distinct. Eye very large, deeply rectangular, 10–12 facets wide (greater number in male). Antenna 1, flagellum with 2–3 calceoli in male, none (apparently) in female. Antenna 2 barely longer than antenna 1, flagellum 6–7-segmented in female, very elongate (>50 segments), and richly calceolate in male. Upper lip, lower margin subacute, not broadly rounded. Mandibular palp, segment 2 with only 5–6 long setae in a distal, submarginal row; segment 3 short, with only 6–10 long, simple, inner marginal setae. Maxilliped, outer plate broadly expanded (about twice width of palp); palp short, extending beyond outer plate only by length of dactyl; apex of inner plate with 2 spine–teeth.

Coxa 1 relatively large, nearly as deep as coxa 2. Gnathopod 1, propod large, long, thumb-like process relatively long, with one subapical spine, posterior margin smoothly convex; basis stout, expanding distally. Gnathopod 2, palm of propod oblique, posterior

angle armed with 1–2 short spines. Coxa 4, posterior excavation more than half depth of plate, lower margin nearly straight. Peraeopods 5–7 relatively short, bases broad, hind margins distinctly serrated or scalloped, segment 4 short, broad (length 1.5 × width), coxa 5 deeper than length of basis. Abdominal side plate 2, hind corner slightly acuminate; hind margin of side plate 3 with 3–6 distinct "notch-and-tooth" serrations, lower corner rounded. Uropod 1, peduncle with 4–6 outer marginal spines, inner margin nearly bare. Uropod 3, rami more broadly lanceolate than in *O. eschrichti*, inner margins nearly bare in the female, but successively more heavily plumose–setose in penultimate and terminal male stages. Telson lobes marginally smooth. Coxal gills medium large, smaller than in *O. eschrichti*, those of peraeopods 5–7 with distinct finger-like inner lobes attached basally.

HOST SPECIES: Not specified by Hurley (1963) in the original description. However, the present material has been taken from the skin surface, usually near the pectoral fins, of the following Pacific fishes: *Sebastes mystinus, S. maliger,* and *S. ruberrimus; Hexagrammos decagrammus,* and the dogfish *Squalus acanthias*. It has occasionally appeared in bottom dredge hauls, especially when demersal fish were also present, and in plankton samples.

LIFE HISTORY: Unknown.

REMARKS ON VARIATION: If the above material is assumed conspecific, adults at maturity range in body length from 6.4 to 9.0 mm (females) and 6.4 to 8.2 mm (males). Larger individuals tend to come from larger hosts (e.g., *Squalus*), and the number of "notch and tooth" dentations on the hind margin of abdominal side plate 3 tends to be in proportion to size of the individual (i.e., 3–4 dentations in smaller animals, 5–6 in larger animals). Adult females carry up to 10 relatively large eggs in the thoracic brood pouch (average is 5–6 eggs).

Amphipod specimens from Puffin Bay, southeastern Alaska (A-170) tended to have heavily spinous uropods and single, dorso-lateral, marginal spines on the telson, whereas the penultimate male from Losa Island (A-173) exhibited 3 lateral marginal spines on the telson, and only 2 notches on the posterior margin of abdominal side plate 3. Such morphological variation may indicate the presence of more than one species of parasitic amphipod in the above material, which was collected from a wide range of fish species. Some parasites could not be assigned to a particular fish host because several potential host species were often captured together in the same gill net or dredge haul sample.

DISTRIBUTION: Aleutian Islands (Scheffer 1959); in present material from southeastern Alaska to southern British Columbia; Washington (Puget Sound) (Dr. C. P. Staude, Friday Harbor Laboratory, pers. comm.), comparable to distributions for host fish species (Hart 1973); central California coast (Hurley 1963).

Opisa odontochela, new species
(Figure 3)

MATERIAL EXAMINED: Puffin Bay, Baranof Island, S.E. Alaska, Stn A-170 (Map stn 198, Bousfield and McAllister 1962), 73 m, gill net, *Sebastes maliger* skin and gill surfaces, 24–25.07.61, HOLOTYPE ovigerous female (4 eggs; 4. 5 mm) (NMNS Cat. No. NMC-C-1986-990).

DIAGNOSIS (ovigerous female, 4.5 mm); A small, large-headed, deep-plated species showing characters of both *O. eschrichti* and *O. tridentata*, but distinguished mainly by (i) the relatively small, upwardly directed propod of the chelate gnathopod 1; (ii) palm of propod lined with close-set "palisade" spines against which closes the posteriorly denticulate dactyl; (iii) the heavy mid-ramal spines of uropods 1 and 2; and (iv) the slender, unarmed margins of the rami of uropod 3.

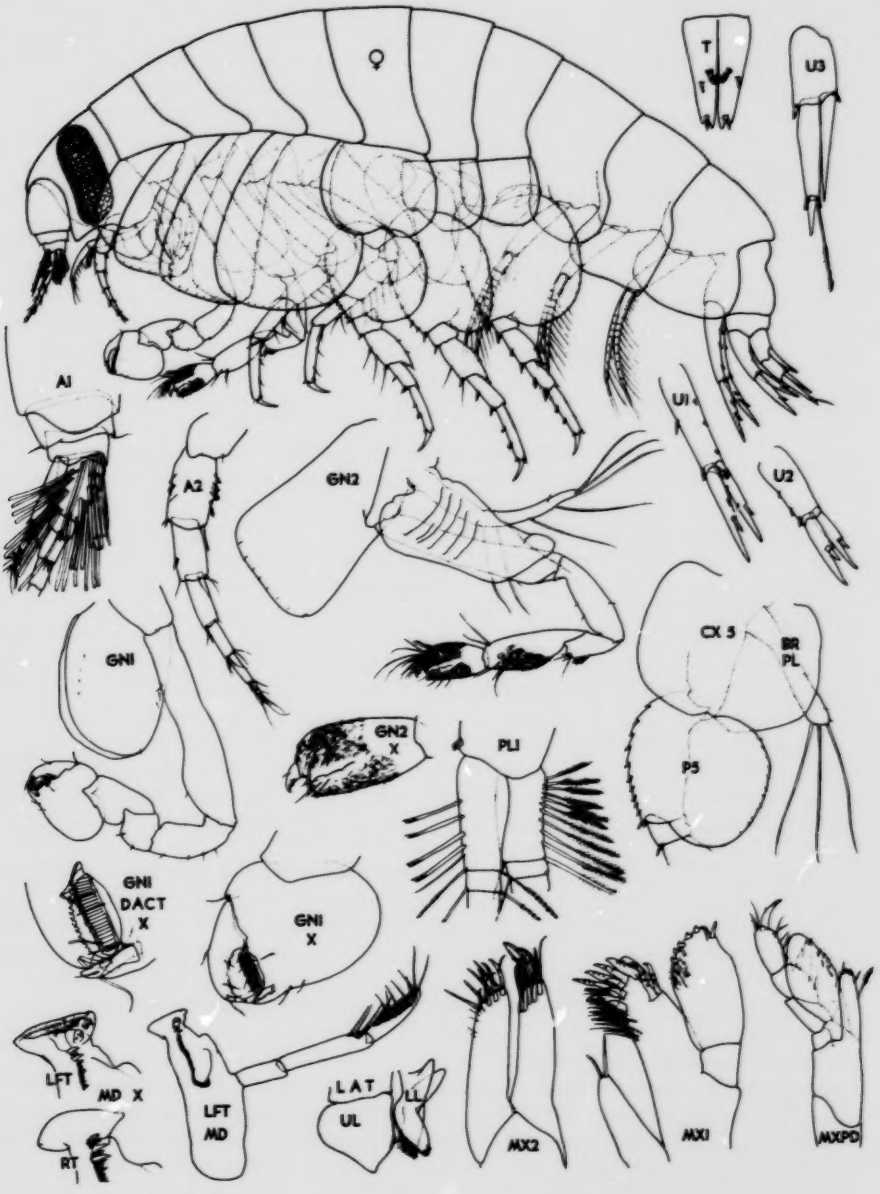

FIG. 3. *Opisa odontochela* n. sp. Puffin Bay, Alaska, ♀ ov. 4.5 mm. (*See p. 37 for legend for figures.*)

Head, anterior head lobe large, subacute; eye very large, vertically subrectangular, with 6–7 vertical rows of pigmented facets (about 100 in total). Antennae short; antenna 1 with 6–7 segments, accessory flagellum 4-segmented. Antenna 2 very small, partly masked by coxae, flagellum 4-segmented.

Mouthparts contained in deep, retrognathous buccal mass. Upper lip subacute below. Mandible, palp slender, elongate, segment 2 with three posterodistal stiff setae; segment 3 with about 7 posterodistal and 2 longer apical setae. Maxilla 1, inner plate tall, with 1–2 apical setae; outer plate apically with outer row of 6 large pectinate spine teeth, and inner, disjunct row of smaller spine teeth, 2 lateral and 3 medial; palp, outer segment very broad. Maxilla 2, plates slender, subtruncate apically, setose apically. Maxilliped, inner plate rounded apically, with 2 button-like spine teeth; outer plate moderately expanded, inner cutting margin with about 5 proximal denticles; palp relatively strong, exceeding outer plate by the dactyl and nearly half the length of segment 3.

Coxal plates 1–4 relatively narrow and deep; posterior marginal excavation of coxa 4 extending more than half depth of plate. Gnathopod 1, basis with distinct anterodistal "bulge"; carpus with distinct posterior lobe; propod ovate, held at 30° upward angle to axis of carpus, posterior margin rounding smoothly and continuously with proximal margin, palm short, straight, armed with about 24 toothed rods, each tightly contiguous and vertical to palm; posterior angle with short, stout, subacute process, armed subapically with two stout spines, that of inner side shorter and slightly sinuous; dactyl stout, strongly curved, inner margin evenly serrate or dentate. Gnathopod 2 not exceptionally elongate, carpus only about 40% longer than propod; palm of propod nearly vertical, posterodistal angle with single spine.

Peraeopods 3 and 4 slender; segment 4, posterior margin armed with 4–5 long, singly inserted setae that are much longer than setae and spine groups of segments 5 and 6; dactyl of moderate length, not elongate. Peraeopod 5, coxa deeper than basis, hind lobe margin distally angled, nearly straight; basis very broad, nearly orbicular. Peraeopod 6, basis deeper than broad, hind lobe rounding distally, posterior margin nearly evenly convex; segment 5 not shorter than 4. Peraeopod 7, basis very broad, hind margin smoothly rounding, minutely serrulate and setulose (as in the other two bases).

Abdominal side plates smooth below; epimeron 3 smooth behind, lacking marginal dentations. Pleopods normal, rami distinctly longer than peduncles. Uropods 1 and 2 slender, rami subequal, shorter than respective peduncles, each ramus with distinct notch in which is set usually a single stout spine. Uropod 3, rami very slender, inner margins unarmed except for single, long, plumose setae at inner distal angle of inner segment of outer ramus; inner ramus very slender, almost rod-like, apex acute. Telson lobes nearly parallel, narrowing distally, fused basally, each with two well-spaced dorso-lateral spines and subapical notch and spine.

Coxal gills relatively small, extending about half (or less) the length of the respective basis; basal accessory lobes of gills 5–7 short, not extending beyond respective coxae. Brood plates relatively short and slender, with a few apical and subapical marginal setae only.

HOST SPECIES: Most likely *Sebastes maliger*. The single specimen of *O. odontochela* was found with a series of *O. tridentata* var. taken from the surface and gills of *S. maliger* at Station A-170.

ETYMOLOGY: The specific name (from Gr. *odontos* — tooth and *chela* — claw) refers to the finely toothed or denticulate hind margin of the dactyl of gnathopod 1.

REMARKS: *O. odontochela* resembles *O. tridentata* in the well developed carpal hind lobe of gnathopod 1, the single palmar spine of gnathopod 2, the acute lower margin of the upper lip, and the sparse setation of the mandibular palp. In balance, however, *O. odontochela* more closely resembles *O. eschrichti* in the less reduced maxilliped palp, the relatively short peraeopod dactyls, the deep coxae and broad bases of peraeopods 5–7, the smooth hind margin of abdominal side plate 3, and the dorso-laterally spinose margins of the telson.

Family TRISCHIZOSTOMATIDAE Bovallius, 1886, emend 1886

Lysianassidae Sars 1895 *partim* (p. 30–31)
Stebbing 1906 *partim* (p. 8–9, 12–13)
Barnard 1969 *partim* (p. 294–295)

This family was first proposed by Bovallius as part of a new tribe, Synopidea, intermediate between the suborders Gammaridea and Hyperiidea. The family was later subordinated within the Lysianassidae by Sars (1895) and Stebbing (1906). The genera *Guerina* and *Trischizostoma*, recognized within the group by Delle Valle (1893), were also combined within the latter genus. To date, at least eight species of the (combined) genus have been recorded and described, mainly from deeper water fishes of the northeastern Atlantic and Mediterranean, south through the Cape Verde Islands and Sierra Leone Basin to South Africa and eastward to Madagascar (Barnard 1969). The present author, however, believes that the characters listed below and in the key (p. 4) are sufficiently basic to warrant resurrection of Bovallius' taxon to full family status within the superfamily Lysianassoidea (Bousfield 1979, 1983); Delle Valle's (1893) distinctions between *Trischizostoma* and *Guerina*, summarized by Sexton (1908), now also appear valid.

Although no members of the family have yet been formally recorded from Canadian waters, the probability of encountering species of the genus *Trischizostoma* here is high, because of the presence of known host species of fish. *Trischizostoma raschi* Boeck, a large (28 mm), fast-swimming animal (Sars 1895, p. 674), has been recorded from the skin of the black dogfish (*Etmopterus niger* (= *E. spinax*); family Squalidae) in deep fjords along the northwestern coast of Norway. This dogfish also occurs commonly in deep Canadian Atlantic coastal waters (Leim and Scott 1966). Moreover, *T. raschi* has been recorded in the North Atlantic west of Iceland (Stephensen 1923), and might therefore be expected in boreal waters of eastern Canada. However, its occurrence in Pacific waters, which few members of Squalidae inhabit, has yet to be recorded.

DIAGNOSIS: Head, rostrum (anterior cephalon) broad[1] produced over base of antenna 1; lateral margin not produced anteriorly, rounded below. Eyes very large, pigmented, multifaceted, meeting dorsally. Antenna 1, callynophore (Lowry 1986) well developed, flagellum short, lacking calceoli. Antenna 2 of moderate length and unarmed in the female, more elongate and calceolate in the male. Mouthparts highly modified, forming a conical bundle beneath head. Upper lip narrow, rounded or slightly notched apically. Lower lip lacking inner lobes, mandibular lobes small. Mandible lacking molar, lacinia, and blade row; incisor narrow, styliform; palp large, with strong brush-like distal setae. Maxillae 1 and 2 styliform, palp very reduced. Maxilliped plates of piercing form, palp well developed.

Coxal plates generally shallow, not deeper than long, coxa 2 largest, deepest. Gnathopod 1 large, powerfully subchelate, may be axially reversed in mature animals; attachment of propod "eusiroidean" in form (i.e., carpus elongate, hind lobe small or lacking). Gnathopod 2 slender, elongate, apically micro-subchelate. Peraeopods 3 and 4 normal, or segment 4 of peraeopod 4 enlarged. Peraeopods 5–7 basically homopodous, increasing in length posteriorly, coxae more or less antero- or postero-lobate, segment 5 not shortened.

Pleosome segments large, powerful, side plates deep. Pleopods strong, inner ramus with proximal spines, both clothespin and uncinate. Urosome segments short, separate. Uropods flattened, rami broadly lanceolate, margins weakly armed. Uropod 3 rami not setose, outer ramus 2-segmented. Telson entire, or apically notched. Coxal gills large, strongly pleated in both sexes, present on peraeopods 2–7. Brood plates large, moderately broad; marginal setae long, numerous.

Type genus and species: *Trischizostoma* Boeck, 1861 (*T. raschi* Boeck)
Other genera: *Guerina* Costa (7 species)

REMARKS: Members of the genus *Trischizostoma* have northern distributions and are parasitic on demersal sharks (e.g., *Etmopterus spinax*). They exhibit "torsion" of the propod and dactyl of gnathopod 1 as adults, but do not show this feature as young, which tend to live on benthic invertebrates such as *Asterias*. Species of *Guerina* have more southerly distributions, do not exhibit gnathopod torsion at any stage, and as adults are found on deepwater bony fishes such as *Chlorophthalmus* (cf. Sexton 1908). According to Sars (1895, appendix, p. 674), *T. raschi* most often has been taken from the skin of the black dogfish, usually on the belly near the anal opening. A great many small eggs have been observed in the brood pouch of the female. Males of this genus have yet to be found.

Family PARDALISCIDAE Boeck, 1870

Pardaliscidae Sars 1895 (p. 401), Stebbing 1906 (p. 220), Barnard 1969 (p. 397), Bousfield 1982 (p. 275)

DIAGNOSIS: Body typically slender, anteriorly smooth; urosome with 1 or more mid-dorsal processes. Head, rostrum moderate, eye weakly or not pigmented. Antennae elongate, first usually the shorter, callynophore well developed in the male; flagella elongate, non-calceolate; accessory flagellum short to medium. Mouthparts modified for carnivorous feeding. Upper lip asymmetrically bilobed. Lower lip, inner lobes small, variable, occasionally fused. Mandible, molar small or lacking; incisor and lacinia with strong cutting edges; palp more or less reduced. Maxillae variably reduced; palp of maxilla 1 variable. Maxilliped, inner plate small, outer expanded, palp various, occasionally stoutly developed and raptorial.

Coxal plates shallow, barely overlapping; coxa 4 weakly or not excavate behind; coxae 5 and 6 anterolobate. Gnathopods strong, similar in form and size, subchelate or simple. Peraeopods 3 and 4 similar, normal. Peraeopods 5–7 basically homopodous, increasing in length posteriorly, bases narrow. Pleosome segments large, side plates deep. Pleopods powerful, especially in the male. Urosome segments short, distinct, often toothed mid-dorsally. Uropods 1 and 2 rami narrowly lanceolate, marginally spinose, inner ramus usually the longer. Uropod 3, rami broadly lanceolate, inner margins plumose-setose, terminal segment of outer ramus small. Telson elongate, deeply bilobate.

Coxal gills simple, or with basal accessory lobe, non-pleated, present on peraeopods 2–7. Brood plates large, moderately broad, margins with numerous long setae.

REMARKS: The family encompasses about 50 species in 18 genera. Most are littoral to bathypelagic, free-swimming, epibenthic predators, but species of at least one genus, *Halicella* (*Rhynohalicella*, in part), are believed to be externally parasitic on fishes (Bousfield 1982).

Genus *Rhynohalicella* Karaman, 1974

Halicella Schellenberg, 1926 (p. 334) (part?)
Halicella Barnard 1969 (p. 402), 1971 (p. 56)
Rhynohalicella Karaman, 1974 (p. 33)

DIAGNOSIS: An aberrant pardaliscid, allied to the *Halice–Pardaliscella–Pardysynopia* complex, but distinct in having the mouthparts highly modified and grouped in a conical prognathous buccal mass. Eyes lacking. Urosome with dorsal processes, weak on segment 1, prominent on 2. Coxae very shallow, elongate (especially coxa 5). Antenna 1 distinctly shorter than antenna 2; flagellar aesthetascs elongate, numerous. Mandible, body elongate; cutting edge of incisor smooth; palp small or button-like, inserted near base. Lower lip narrow, lacking inner lobes. Maxilla 1, outer plate and palp styliform, inner plate lacking.

Maxilla 2 plates styliform, inner plate small or lacking. Maxilliped small, outer plate with outer cutting edge and apical spine teeth, palp reduced, 3–4 segmented, inner plate lacking.

Gnathopod 1 raptorial in form, simple or appearing subcheliform, palm of propod very oblique, spinose, with several spines at raised posterior angle. Gnathopod 2 appearing simple, palm with long, submarginal, distally pectinate setae. Peraeopod 4, especially segment 5, appearing slightly stronger than 3. Peraeopod 6 slightly longer than 7, dactyls elongate. Uropod 1, rami subequal, peduncle with medio- and laterodistal processes overhanging base of subequal rami. Uropod 3, outer ramus distinctly the longer, both rami with strongly plumose–setose inner margins. Telson lobes very elongate, fused basally, apices notched.

Coxal gills large, sac-like, largest on gnathopod 2 smallest on 7.

Type species: *Halicella halona* J. L. Barnard, 1971.

Key to species of pardaliscoidean fish parasites

1 Gnathopod 1, palm of propod slightly concave, dactyl short (one-half palm); each telson lobe apically tridentate; mandibular palp distinctly 3-segmented; maxilla 2 with small inner plate ..... *Halicella parasitica* Schell

Gnathopod 1, palm of propod distinctly concave, dactyl long, falcate, tip closing inside posterodistal palmar prominence; telson lobes singly notched apically; mandibular palp a tiny button near base of body; maxilla 2, inner plate lacking ..... *Rhynohalicella halona* (Barnard) (p. 16)

Rhynohalicella halona (J. L. Barnard, 1971),
(Figure 4)

Halicella halona Barnard, 1971 (p. 56–70, fig. 35–37)

MATERIAL: Mouth of Burrard Inlet, Strait of Georgia, B.C., ELB Stn P4 (see Bousfield and Jarrett 1981), 110 m, naturalist's dredge, 02.11.77, 1 ovigerous female (6.5 mm) (NMNS Cat. No. NMC-C-1986-991).

DIAGNOSIS: Head, anterior process moderately strong, subacute, lower margin very oblique. Antenna 1, flagellum 22-segmented, proximal segment conjoint with long, singly inserted, anterior marginal aesthetascs on it and the immediately distal, shorter segments; accessory flagellum of two free segments, second segment very short. Antenna 2 distinctly (nearly 50%) longer than 1, flagellum 18-segmented, shorter than peduncle.

Mandibular palp a small "button" near the base. Maxilla 1, inner plate lacking; palp appearing 1-segmented. Maxilla 2, inner plate lacking; outer plate attenuated distally. Maxilliped, outer plate large, tip barely exceeded by weakly geniculate 4-segmented palp.

Coxal plates 1 and 2 shallow, length much greater than depth. Gnathopod 1, palm of propod elongate, distinctly concave, weakly spinose toward hinge, posterodistal angle forms a raised process armed with 4–5 stout spines; inner face of propod with row of about 12 long, simple setae; dactyl elongate, strongly curved, closing inside palmar process. Gnathopod 2, carpus and propod subequal in length; propod, palm continuous with posterior margin, lined with 6 long, heavy, pectinate setae; inner face with about 12 oblique rows of short setae; dactyl strongly curved distally.

Peraeopod 4 slightly heavier and longer than 3; length of dactyls nearly equal to respective propods. Peraeopods 5–7, coxae very shallow, lengths 3–4 times respective depths. Abdominal side plates 2 and 3, hind corners weakly acuminate. Uropods 1 and 2, peduncles with single row of short, baso-facial setae; in uropod 1, posterodistal processes less strongly produced, but rami more acutely lanceolate distally and more strongly spinose than in *H. parasitica*. Uropod 3, inner margins of rami lined with 10–12 plumose setae;

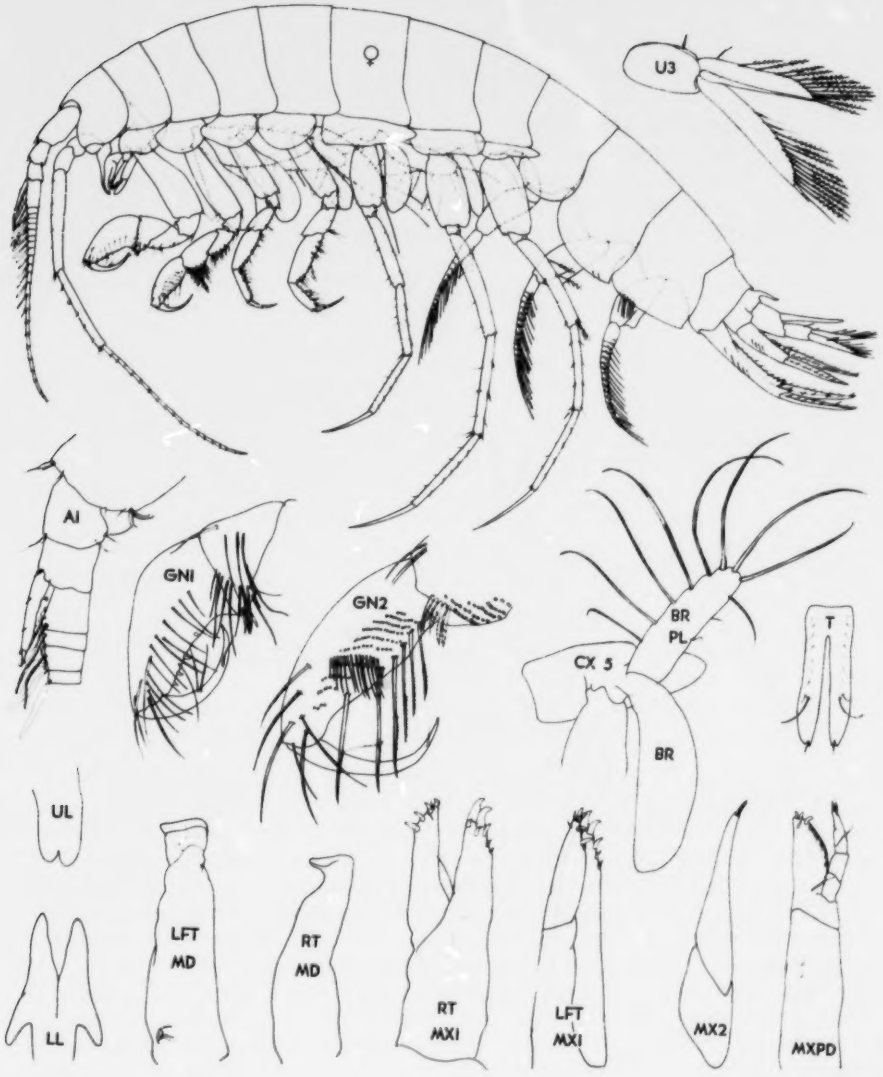

FIG. 4. *Rhynohalicella halona* Barnard. ELB STN. P4, Burrard Inlet, B.C. 110 m dredge. ♀ ov. 6.5 mm. (*See p. 37 for legend for figures.*)

terminal segment of outer ramus very small, with short apical setae. Telson elongate (two-thirds length of uropod 3), lobes with single apical notch and seta. Coxal gills sac-like, longer than respective bases anteriorly, decreasing in size posteriorly. Brood plates moderately broad, smaller and more slender on peraeopod 5, margins with long, widely spaced simple setae.

HOST SPECIES: Unknown. Bousfield (1982) has referred to members of the halicellid group as ectoparasitic on fishes, based on the inference of a parasitic mode of feeding suggested by the conical, prognathous "piercing" form of the buccal mass and the reduced and modified mouthparts. These structures resemble those of the ectoparasitic *Opisa*, *Lafystius*, and *Trischizostoma*. Also typical of semi-parasitic (facultative) amphipods are the numerous elongate antennal aesthetascs in both sexes and the raptorial form of the first gnathopods, with excavate palm and spinose, posteriorly angled process that appears basically similar in form and function to gnathopod 1 of *Opisa*. Although Schellenberg (1926) did not elucidate the origin of the specific name "*parasitica*", his choice is suggestive of its probable lifestyle.

REMARKS: Barnard (1971) suggested that differences between his species and that of *H. parasitica* Schell. might justify separate generic recognition. Schellenberg's (1926) original material from the Antarctic consisted of a single brood female (8.5 mm) and two subadult females, whereas Barnard figured a 5.6 mm male. Slight morphological differences between the 6.5 mm female figured here, and that of the male specimen of Barnard are possibly attributable to sexual dimorphism. Karaman (1974) however, assigned Barnard's species *halona* to a new genus *Rhynohalicella* based mainly on the distinctive nature of the mouthparts. The writer concurs with that decision.

Family LAFYSTIIDAE

Laphystiidae Sars, 1895 (p. 382)
Lafystiidae Stebbing 1906 (p. 208)
Lafystiidae Barnard 1969 (p. 281)

DIAGNOSIS (modified from Bousfield 1982): Body broad, somewhat flattened, dorsally smooth. Head broadened, with large rostrum overhanging base of antenna 1. Eyes usually large, multifaceted, more or less protruding from head surface. Peraeopods 3–7 prehensile; segment 6 stout, dactyl large, curved or hooked. Coxae 1–4 moderately deep, increasing in size posteriorly; coxae 5 and 6, posterior lobe often attenuated below, especially in the female. Abdominal side plates deep; pleopods usually well developed. Urosome slender; uropods slender, weakly armed, rami lanceolate, outer ramus shorter than inner; uropod 3, outer ramus 1-segmented, tips of rami rounded. Telson plate-like entire.

Antennae short. Antenna 1 stout, usually longer than antenna 2; peduncular segments short; flagellum with numerous anterior marginal aesthetascs; accessory flagellum lacking. Antenna 2 slender. Mouthparts modified, reduced; buccal mass subconical, retrognathous. Upper lip rounded below. Lower lip lacking inner lobes. Mandible lacking molar; incisor attenuated; lacinia narrow, slender-toothed; blade-row lacking; palp strong, inner (posterior) margin of segment 3 lined with pectinate setae. Maxilla 1, palp vestigial; inner plate weakly armed, outer plate with 10–11 apical (large) and subapical spine-teeth. Maxilla 2, plates subequal, apically setose. Maxilliped, inner plate narrow; outer plate broad, inner distal margin with cutting edge; palp very reduced, 1–2-segmented.

Gnathopod 1 slender, elongate, simple; dactyl elongate, unquis modified. Gnathopod 2 weakly subchelate; segments 4–6 short; dactyl large, apically modified, overhanging short palm. Peraeopods 3 and 4, segments 4 and 5 short, 4 overhanging 5. Peraeopods 5–7 subequal in length; bases variable in size and shape, often with inner facial plumose setae.

Coxal gills sac-like or sublinear, largest on peraeopod 5, present or absent on peraeopod 7. Brood plates medium to broad, margins with relatively few long setae.

External sexual dimorphism slight. Males have relatively larger eyes, stronger rostrum, and more numerous aesthetascs on antenna 1; females tend to have a more strongly produced hind lobe of coxa 5 and are larger in body size.

These species are parasitic or semi-parasitic on the gills, mouth fringes, and external surfaces of demersal fishes.

REMARKS: The relationship of family Lafystiidae to other gammaridean families presents some problems. Bousfield (1978, 1982, 1983) has placed the family, somewhat tentatively, in the superfamily Stegocephaloidea. Following somewhat after Sars (1895), this decision was based mainly on its resemblance to members of the stegocephaloidean family Acanthonotozomatidae in the shape of the rostrum, antennae, buccal mass, and on the reduction of mouthparts, the ventrally acuminate coxal plates, dissimilar gnathopods, homopodous peraeopods, lanceolate uropods, plate-like telson, unmodified coxal gills and broad brood plates, and plate-like telson. However, many of these features are shared with families of the superfamilies Eusiroidea and Leucothoidea. Thus, family Lafystiidae is undoubtedly closely related to family Laphystiopsidae, members of which are found in association with benthic invertebrates (Sars 1895; Vader and Romppainen 1987), and which has been placed within the Leucothoidea (Bousfield 1982, 1983). The form of the rostrum, eyes, and antennae, all sexually dimorphic, are especially reminiscent of members of family Pleustidae (Leucothoidea). The latter also have modified mouthparts, homopodous peraeopods, lanceolate uropods, plate-like telson, and unmodified coxal gills, lacking on peraeopod 7. Clearly, a more extensive and comprehensive multiple-character analysis is required to establish more clearly the true phyletic relationships of all these higher taxonomic groups.

Key to genera of Lafystiidae in Canadian waters

1 Head distinctly wider than long, rostrum apically truncate (dorsal view); peraeopods 5–7, bases (segment 2) of differing shapes but generally oval and broad; segments 4 and 5 subequal in length; abdominal side plates 2 and 3 narrow, deep; urosome segment 1 elongate, length twice depth (lateral view); peraeopod 7 lacking coxal gill 2

Head not wider than long, rostrum apically rounded; peraeopods 5–7, bases similar in form, all broadly expanded posteriorly, segment 5 much shorter than 4; abdominal side plates 2 and 3 normal, about as wide as deep; urosome segment 1 not elongate, length slightly greater than depth; peraeopod 7 with coxal gill ..... *Protolafystius*, n. g. (p.31)

2 Peraeopod 3 slightly the strongest, 4–7 about equally strongly developed (especially segment 6) and prehensile; coxa 6, hind lobe deep, attenuated in both sexes; gnathopod 2, palm straight, tip of dactyl forming minute chela; maxilliped palp 2-segmented ..... *Lafystius* Krøyer (p.20)

Peraeopods 3 and 4 distinctly more powerfully prehensile than peraeopods 5–7; coxa 6, hind lobe shallow, rounded below; gnathopod 2, palm convex, dactyl attenuated at tip; maxilliped palp appearing 1-segmented ..... *Paralafystius*, n. g. (p.30)

Genus *Lafystius* Krøyer, 1842

Laphystius Sars 1895 (p. 383–384, pl. 134)
Lafystius Stebbing 1906 (p. 208–209)
Lafystius Barnard 1969 (p. 283)

DIAGNOSIS: Body relatively short and compact. Head usually elevated anteriorly at an angle, antero-lateral head margin rounded, distinctly broader than long, rostrum apically subtruncate, shallowly notched anteriorly. Eyes large, rounded, regularly multifaceted.

Antenna 1, peduncular segments stout, flagellum 7–10-segmented; antenna 2 slender, peduncle 5 longer than 4, flagellum 5–8-segmented.

Upper lip weakly produced and slightly incised apically. Mandible, left lacinia tridentate, right lacinia bicuspate or simple; palp segment 3 sublinear, facially finely setose, inner (posterior) margin distally with short stiff pectinate setae; maxilla 1, inner plate subtruncate with few apical setae; outer plate short, apex subtruncate, bearing several large spine-teeth and >4 smaller inner "shoulder" spines; maxilla 2, plates normal; maxilliped palp 2-segmented; inner plate extending past base of palp.

Coxal plates 2–4 deeper than broad, 1 not conspicuously smaller than 2, 4 strongly acuminate below. Coxae 5 and 6, hind lobe produced and acuminate below, coxa 5 weakly so in male. Gnathopod 1, propod armed distally with short stiff split-tipped setae. Gnathopod 2, propod palm short, distal angle acute, hind margin setose; dactyl with acute process behind unguis, together forming a minute pincer (microcheliform).

Peraeopod 3 slightly the strongest, 4–7 about equally strongly prehensile. Segments 4 and 5 of peraeopod 4 longer than in peraeopod 3. Peraeopods 5–7, bases unlike, subovate and with rounded distal lobes in 5 and 6, subrectangular and broader in peraeopod 7, inner faces with plumose setae; segment 5 about equal to 4; segment 6 of peraeopod 7 anteriorly spinose.

Pleon side plates (esp. 2 and 3) narrow, deeper than wide. Pleopods strong, rami >10-segmented. Urosome segment 1 slender, elongate; uropod 1 elongate, peduncle longer than rami; uropod 3, rami very weakly armed marginally. Telson apically rounded.

Coxal gills all sac-like, lacking on peraeopod 7. Brood plates all broad.

Type species: *Lafystius sturionis* Krøyer, 1842.

Other species: *L. morhuanus*, new species
L. acuminatus, new species
L. frameae, new species
Lafystius species Holmes, 1905 (as *L. sturionis*).

Key to North Atlantic species of *Lafystius*

1 Eyes large, each usually with more than 25 facets, appearing to cover one-half or more of side of head; gnathopod 1, propod with conspicuous postero-distal marginal spines; on body & under fins and operculum of various fishes 2

Eyes small, each usually with few (less than 25) facets, covering less than half side of head; gnathopod 1, propod apparently lacking postero-distal spine or setal groups; on mouth fringes of *Lophius americanus* ..... *Lafystius* sp. (p. 29)

2 Eyes medium large (25–35 facets usually); gnathopod 1, propod with 7–11 anterodistal spines; antenna 1, flagellum 9–11 segmented; mandibular palp, segment 3 with 10+ posterior marginal setae 3

Eyes very large (35–60 facets, usually); gnathopod 1, propod with 4–6 antero-distal marginal spines; antenna 1, flagellum 5–8 segmented; mandibular palp segment 3, posterior margin with 6–8 setae 4

3 Epimeral plate 2, hind corner produced, acute; gnathopod 2, tip of dactyl with unequal spine and postero-distal process; maxilla 1, inner plate with 3 apical setae ..... *L. sturionis* L.

Abdominal side place 2, hind corner not produced; gnathopod 2, tip of dactyl with subequal spine and postero-distal process; maxilla 1, inner plate with 2 (1) apical setae ..... *L. morhuanus*, n. sp. (p. 21)

4 Eye with about 40 facets; peraeopod 6, coxa very deep behind, = 4/5 length of basis; peraeopod 7, basis with proximo-medial setae only; gnathopod 2, propod, postero-distal angle nearly square ..... *L. frameae*, n. sp. (p. 26)

Eye with about 60 facets; peraeopod 6, coxa shallow behind, about half depth of basis; peraeopod 7, basis with distinct clusters of proximal and distal inner facial setae; gnathopod 2, propod, postero-distal angle strongly produced, acuminate; ..... *L. acuminatus*, n. sp. (p. 26)

Lafystius morhuanus, new species
(Figures 5 and 6)

Laphystius sturionis Smith, in Verrill 1873 (p. 457, 459), 1873 (p. 557)
Lafystius sturionis Stebbing 1888 (p. 899, plate 137D?)
Lafystius sturionis Holmes 1905 (p. 492 *partim*, *non* fig.24)
Lafystius sturionis Wise 1958 (p. 72)
Lafystius sturionis Rathbun 1905 (p. 87 *partim*)
Lafystius sturionis Bousfield 1973 (p. 141 *partim*, plate 39)
Lafystius sturionis Appy and Burt 1982 (p. 1576)

MATERIAL EXAMINED:

GULF OF ST. LAWRENCE (GIROQ Coll. of Dr. Pierre Brunel):

Cap Corbeau, Île du Havre (Mingan Archipelago) near Havre-Sainte Pierre, Quebec (50°13′15″N,63°35′45″W), 1–25 m (infralittoral), SCUBA, *Myoxocephalus scorpius* dorsum, 19.09.84, 1 ovigerous ♀ (6.2 mm) (NMNS slide mount), 3 other ovigerous ♀ ♀, 1 ♀ subadult, 1 ♂ adult (5.4 mm) (NMNS slide mount), 13 imm. and juv. (B. Thomas, coll.).

BAY OF FUNDY:

St. Croix estuary near Biol. Stn., St. Andrews, N.B.: on cod, 6.07.12, 1 ovigerous ♀ (7 eggs; 6.1 mm), 1 ♂ (4.2 mm) (NMNS Cat. No. NMC-C-1986-992), 11.08.12, 1 ♂ adult (4.5 mm) (slide mount), 2 other ♂ ♂ adults, 2 ♀ ♀ subadults, 2 imm. (NMNS Cat. No. NMC-C-1986-993); trawled, haddock *Melanogrammus aeglefinus*), 4.07.12, 1 ♂ (4.0 mm) (NMNS Cat. No. NMC-C-1986-994, slide mount); near wharf, on sculpin (*Myoxocephalus* sp.), 17.07.12, 1 imm. (3.0 mm) (NMNS Cat. No. NMC-C-1986-995), 30 m, trawl, from *Gadus morhua* skin and under pectoral and pelvic fins, 06.09.30, HOLOTYPE ovigerous ♀ (7.5 mm) (slide mount, NMC-C-1986-996), 1 ♂ adult ALLOTYPE (5.2 mm)

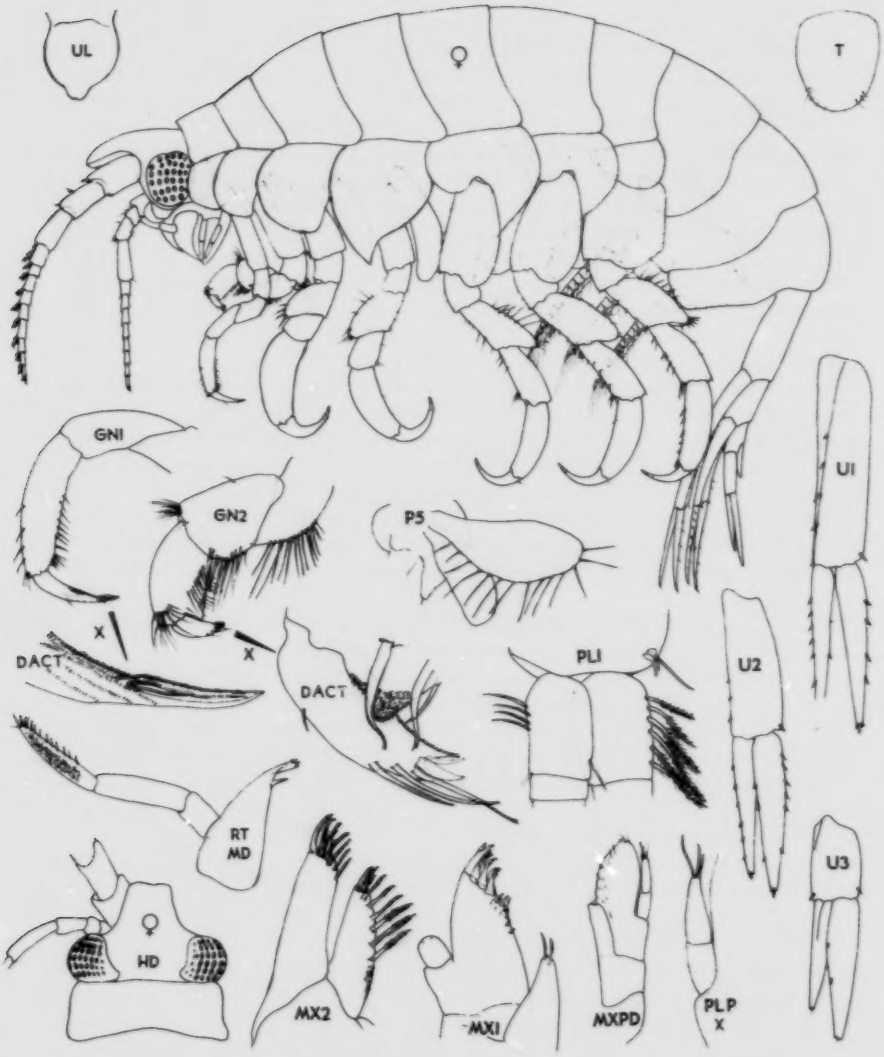

FIG. 5. *Lafystius morhuanus*, n. sp. Passamaquoddy Bay, N.B., St. Croix estuary. Under pectoral fin of codfish, A.G. H. coll. — ♀ ov. 7.5 mm.(*See p. 37 for legend for figures.*)

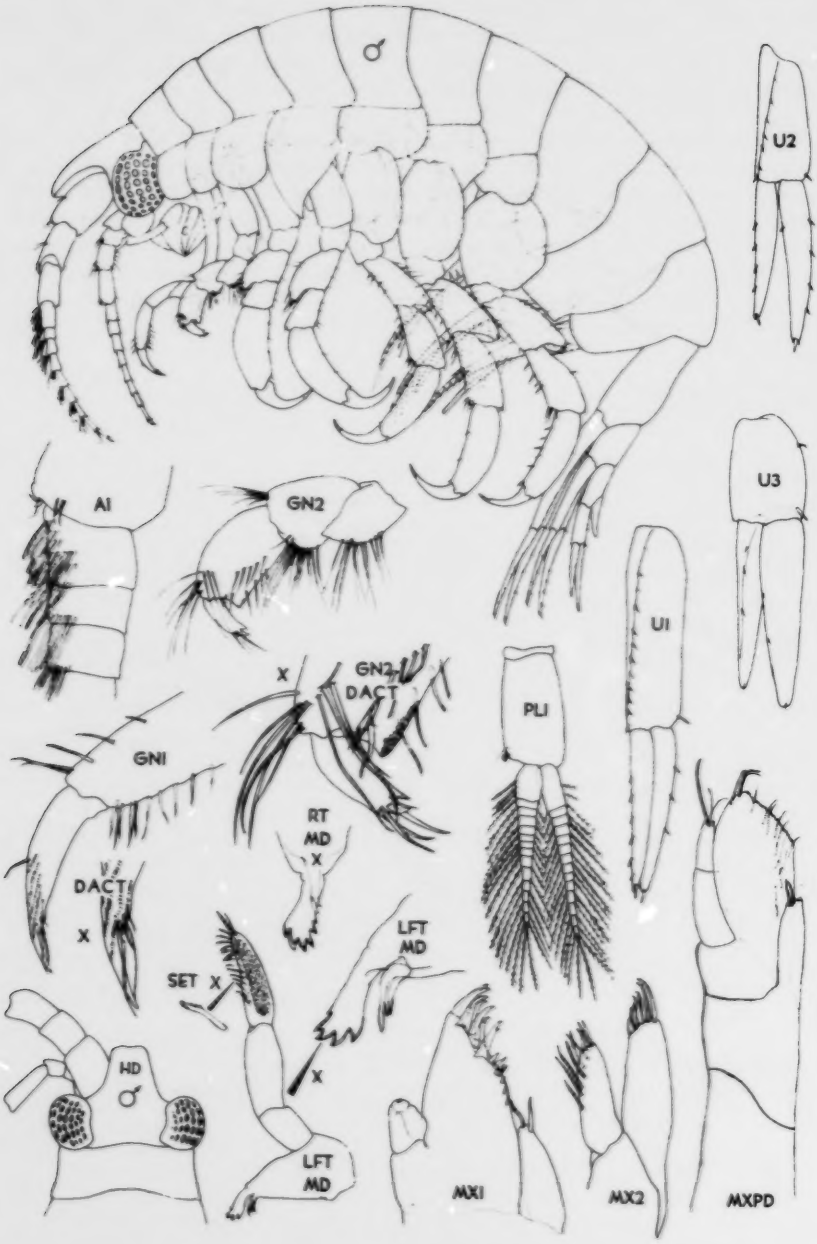

FIG. 6. *Lafystius morhuanus*, n. sp. St. Croix estuary, Passamaquoddy Bay. Under pectoral fin of cod — ♀ 5.2 mm. (*See p. 37 for legend for figures.*)

mount, NMC-C-1986-997), PARATYPES: 1 ovigerous ♀ (5.2 mm) (slide mount), 3 other ovig. ♀ ♀ (5–6 eggs; 5.0 mm), 1 ♂ adult (4.6 mm) (slide mount), 5 other ♂ ♂ (4.0 mm), 10 imm. and juv. (NMNS Cat. No. NMC-C-1986-998), 1 ovig. ♀ (6.2 mm), 1 other ♀ (6.0 mm), 1 ♂ adult (3.8 mm) (A. G. Huntsman, coll.) (Environment Canada Identification Centre, St. Andrews, N.B., Cat. No. 294):

Passamaquoddy Bay region (Env. Canada Ident. Centre Cat. No. 294):

Passamaquoddy Bay: 75 m, on ocean pout (*Macrozoarces americanus*), 5.10.76, 1 ovig. ♀ (6.8 mm) (M. Dadswell, coll.); from *Gadus morhua* under pectoral fin, 22.11.77, 1 ovig. ♀ (6.3 mm), 1 ♂ adult (4.0 mm) (slide mount) (R. G. Appy, coll.). Western Passage: 75 m, shrimp trawl, on thorny skate (*Raja radiata*), 31.10.77, 1 ovig. ♀ (7.0 mm) (slide mount), 1 other ovig. ♀ (6.8 mm, 11 eggs); 75 m, shrimp trawl, from smooth skate (*R. senta*), 3.11.77, 1 ♂ subadult (3.8 mm); 75 m, trawl, little skate (*R. erinacea*), 9.12.77, 1 ♂ adult (4.0 mm) (slide mount) (R. G. Appy, coll.).

Gulf of Maine (northeast Georges Bank): 41°53′N, 66°14′W, 82 m, *Gadus morhua* pectoral fin, 01.04.57, 1 ovig. ♀ (7.0 mm), 1♂ (4.9 mm) (R. L. Wigley, coll.).

DIAGNOSIS (ovigerous female, 5.2 mm): Rostrum slightly deflexed towards apex. Eye very large, usually with 25–40 pigmented facets, covering three-quarters side of head, not quite reaching anterior margin, but may be partly hidden behind by coxa 1. Antenna 1 slightly longer and heavier than antenna 2; peduncular segments smooth posteriorly; flagellum 8–10-segmented, basal segment conjoint, with 3–4 groups of anterior marginal aesthetascs, 3–4 per group. Antenna 2, peduncular segment 4 with anterodistal and posterior marginal short setae; flagellum 7–9-segmented.

Mandible, palp segment 3, posterior margin lined with 10–14 pectinate stiff setae, apex with 2 larger setae; left lacinia trifid, right lacinia bifid (often appearing as a simple spike), incisor 5–6 toothed. Maxilla 1, outer plate mediodistally oblique, apex with 7 stout outer, and 4 small inner spine-teeth and a few short setae; inner plate typically with 2 apical setae. Maxilliped, palp with 3 apical setae, distinctly not reaching tip of outer plate that has a denticulated, oblique, inner distal cutting margin; inner plate with 2 apical spines and 2 setae.

Gnathopod 1, segment 6 longer than 5, anterior margin with 4–5 distal, mostly singly inserted setae, posterior margin with 7–10 singly or doubly inserted simple setae; dactyl, length about three-quarters propod, body distally "striated" with rows of micropores, unguis narrowly spoon-shaped. Gnathopod 2, propod length nearly twice its depth, with several slender, split-tipped, facial and posterior marginal spines; palm short, slightly concave, minutely pilose, less than half length of dactyl; dactyl with 2–3 long slender anterodistal spines (near base of nail), posterodistal process attenuated, reaching nearly to tip of unguis.

Peraeopods 3 and 4, segment 4 with 5–10 anterior marginal and distal short setae; segment 6 with 2–3 minute posterior marginal setules. Peraeopods 5 and 6, posterior lobe of coxa produced acutely ventrally, extending more than half length of respective basis; segment 4 with anterior and posterior marginal slender setae; segment 5 with anterior marginal short setae only; segment 6, margins virtually unarmed; bases with 2–4 inner distal facial plumose setae. Peraeopod 7, posterior margin of basis obtusely angled distally, proximal margin straight, weakly crenulated, inner face with midline row of 10–12 long, plumose setae; segment 6 with 5–6 short anterior marginal spines.

Abdominal side plate 2, lower hind "corner" weakly produced. Pleopod rami 15-segmented; tips of clothespin spines (3–5 per inner ramus) appearing simple. Uropod 1, rami subequal, outer margin of inner ramus bare. Uropod 2, outer ramus distinctly the shorter, inner margin bare. Uropod 3, outer ramus about three-quarters length of inner, inner margin of both rami unarmed, tips rounded or truncated, with minute apical seta. Telson apically rounded, margin with 4–5 short setules.

Coxal gills 2–4 sublinear, successively longer, 5 and 6 broadly sac-like. Brood plate on peraeopod 5 relatively broad, anterior margin with 10–14 simple setae. Ovigerous females carry 4–6 eggs or young, each up to 1.2 mm in length.

Male (4.0–4.9 mm): Differing from female mainly in smaller size and in the following traits (i) rostrum relatively longer and narrower (slightly), (ii) eyes distinctly larger, covering anterior and ventral head margins, and approaching more closely mid-dorsally, (iii) antenna 1, aesthetascs on proximal flagellar segments in rows of 7–10, (iv) coxa 5, hind lobe only slightly produced ventrally, (v) pleopod inner rami with bifid clothespin spines, (vi) uropod 1, outer margin of peduncle with 10–12 short spines, approximating margins of both rami unarmed, (vii) uropod 3 outer ramus, both margins unarmed, (viii) coxal gill on peraeopod 2 relatively short, distally acuminate, gills on peraeopods 4–6 broadly sac-like.

HOST SPECIES: *Gadus morhua* L. (Atlantic cod). Recorded here also from *Melanogrammus aeglefinus*, *Myoxocephalus scorpius*, *Macrozoarces americanus*, and three species of skates (*Raja radiata*, *R. erinacea*, and *Malacoraja senta*).

Specimens of "*Lafystius sturionis*" recorded by Holmes (1905) from the fleshy mouth tendrils of the goosefish (*Lophius americanus*) are almost certainly attributable to a distinct (new) species. Fresh material should be examined and described to clarify its taxonomic status (see below, p. 25). Similar treatment should be given the material of this species recorded from "*Cottus*" sp. off Halifax, Nova Scotia, by Stebbing (1888). His figures of the mouthparts indicate important differences between characters of the mandibular palp, plates of maxilla 1, and outer plate and palp of the maxilliped and those of *L. morhuanus* and *L. sturionis*.

REMARKS ON VARIATION: If the above specimens are indeed conspecific, adults at maturity in this species range in body length from 5.0 mm to 7.5 mm (females) and 3.8 mm to 5.4 mm (males). There is no clear relationship between size of the amphipod and size of its host. Variation in morphology is also evident. For example, in the 4.0 mm male from *Raja erinacea*, the rostrum is gently and evenly deflexed distally, and the rami of uropod 3 appear almost subequal, whereas in a slightly larger (4.5 mm) male from an unspecified host in the same region, the rostrum was strongly deflexed distally, and the rami of uropod 3 are distinctly unequal in length. Moreover, a 4.0 mm male from a haddock (*Melanogrammus*) taken in a trawl in the St. Croix estuary 4 July 1912 (NMNS Cat. No. 2357 above) exhibited a large eye (40–50 facets), short flagella of antennae 1 and 2 (6 and 5 segments, respectively); a short ventral process on the hind lobe of coxa 6, and no marginal spinules on the rami of uropod 3. However, a 4.5 mm male specimen taken at the same locality later that summer from an unspecified host exhibited a relatively strongly distally deflexed rostrum, a very large eye (more than 60 facets), longer antennae (8 and 7 flagellar segments, respectively), a deep ventral process on the hind lobe of coxa 6, and 2 marginal spinules on the outer ramus of uropod 3. The 7.0 mm ovigerous female from *Raja radiata* (above) had a relatively short deflexed rostrum, oval eyes, and narrow brood plate on peraeopod 5, compared to the type specimen (ovigerous female) from *Gadus morhua* (above). The morphological variation noted above should be further studied in a more extensive series of specimens from various species of fishes.

Previous references to North American Atlantic specimens of *Lafystius* frequently involve the Atlantic cod (*Gadus morhua* L.) as the host fish (e.g., Wise 1958; Bousfield 1973). Illustrations herein are based on specimens from this cod, the most frequent host of specimens examined above. In this vein, sufficient differences exist between North American amphipod material from *Gadus morhua* L. and European Atlantic material from European cod (*G. callarias* L.) to warrant redescription of the former as a distinct species. Except for the material of Holmes (1905), the morphological variants from various fish hosts in North American waters have been included under the new species *L. morhuanus* for the present. However, two specimens taken as free-swimmers from waters south of Cape Cod

appear to be different species again. They are described below. The genus *Lafystius* could be expected to occur on some fishes of the Arctic and North American Pacific regions (e.g., on *G. ogac* and *G. macrocephalus*, respectively). Existing records of *Lafystius* species from those regions (e.g., Jensen et al. 1982, off California on *Sebastes paucispinis*; Park 1961, in Puget Sound on an unspecified host) may prove to be distinct (new) species (see p. 33).

Lafystius acuminatus, new species
(Figure 7)

MATERIAL EXAMINED: Southern gulf of Maine, about 105 km ESE of Nantucket, Albatross Stn 70 (41°09′N,68°56′W), 55 m depth, net sample, 18.12.55 (R. L. Wigley, coll.), HOLOTYPE ovigerous female (5.0 mm) (NMNS Cat. No. 14043, slide mount).

DIAGNOSIS: Similar to *L. morhuanus* and *L. sturionis*, but distinguished by the characters given in the key (above) and by the following traits: (i) head and rostrum relatively long, greater than first two peraeonal segments, (ii) antenna 1, flagellum 8-segmented, segments strongly armed with aesthetascs, (iii) antenna 2, flagellum 6-segmented, (iv) mandible, palp segment 3 with 7 posterior marginal and 2 apical pectinate setae, (v) left and right incisors with 4 and 5 cusps, respectively, (vi) gnathopod 1, propod armed anterodistally with 4, and posterodistally with 5 short setae (singly or paired), (vii) gnathopod 2, propod with about 10 long facial setae, palmar posterior angle distinctly produced, sharply acuminate, (viii) dactyl, inner distal process extending about length of unguis, forming an equally lobed micro-pincer, (ix) peraeopods 3 and 4, segment 4 with 4–6 anterior marginal setae; propod (segment 6), especially of peraeopod 3, very stoutly developed, (x) peraeopods 5 and 6, hind coxal lobe acuminate, extending two-thirds to three-quarters depth of basis; bases similar, broadly rounding behind and little expanding distally, inner faces each with about 3 distal, plumose setae, (xi) peraeopod 7, hind margin nearly evenly rounded posteriorly, margin without sharply demarcated distal obtuse angle; inner face with about 10 plumose setae along mid-line, (xii) uropods 1–3, inner:outer ramal marginal spine formulae are 3:2, 5:2 and 3:3, respectively, (xiii) pleosome side plate 2, hind corner acuminate, lower margin with 7 small spines, (xiv) brood plate on peraeopod 5 moderately and nearly uniformly broad, anterior distal margin with about 12 long, simple setae.

HOST SPECIES: Unknown.

ETYMOLOGY: The species name (from L. *acumen-inis* — point) alludes to the sharply produced (acuminate) process of the palmar angle of gnathopod 2.

Lafystius frameae, new species
(Figure 8)

MATERIAL EXAMINED: Atlantic Ocean, New York Bight off New Jersey, U.S. Fish and Wildlife Station 705, dredge over sludge, 1970, HOLOTYPE male (4.0 mm) (A. B. Frame, coll.) (NMNS Cat. No. NMC-C-1986-999).

DIAGNOSIS (Male 4.0 mm): Similar to *L. morhuanus* but differing in characters given in the key and as follows, (i) head and rostrum relatively long, much longer than peraeon segments 1 and 2 combined, (ii) eye of moderate size, not reaching anterior or posterior head margins, with 30–35 pigmented facets, (iii) antenna 1, peduncular segment 1 appearing distinctly longer than 2 and 3; flagellum 8-segmented, (iv) antenna 2, flagellum 7-segmented, (v) mouthparts generally similar to those of *L. morhuanus*, but mandibular palp,

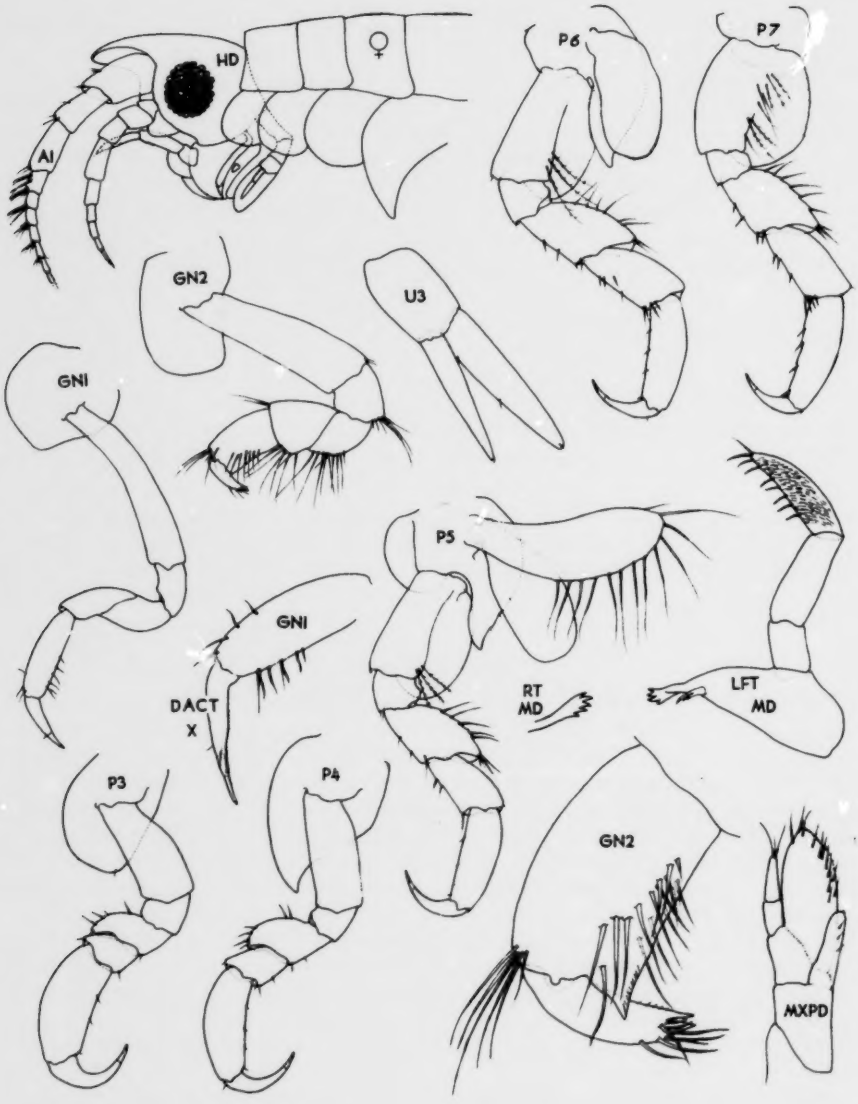

FIG. 7. *Lafystius acuminatus*, n. sp. Off Nantucket Is., Cape Cod. MA. Alb-70 (41°08′ N., 68°56′ W.). ♀ ov. 5.0 mm. (*See p. 37 for legend for figures.*)

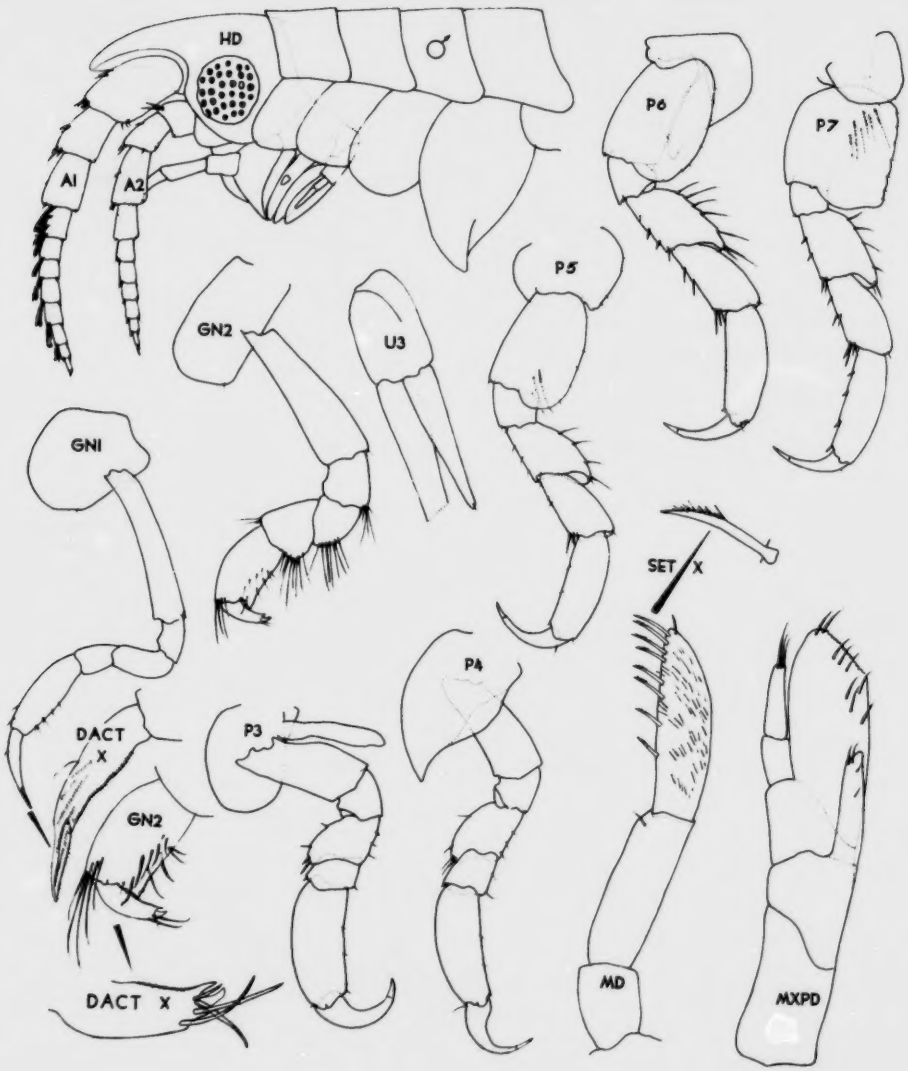

FIG. 8. *Lafystius frameae*, n. sp. New York Bight, Stn. 5, 1970. ♂ 4.0 mm. (*See p. 37 for legend for figures.*)

segment 2 with distal seta; segment 3, posterodistal margin with 8 pectinate setae and a very short apical seta, (vi) maxilliped, outer plate relatively narrow, little expanded medially; palp short, extending barely beyond obtuse angle of inner distal margin of outer plate, (vii) gnathopod 1, propod distinctly longer than carpus, armed anterodistally with 1–2 setae and posterodistally with about 4 weak setae or setal groups; dactyl distinctly curved, unguis narrowly spoon-shaped, (viii) gnathopod 2, propod with about 6 facial long setae; palmar posterodistal angle produced, rounded not acuminate; dactyl, bifid tips of unequal length (process shorter than unguis), (ix) peraeopods 3 and 4, segment 4 with 4 anterior marginal setae, (x) peraeopod 5, coxal hind lobe short, apex blunt, (xi) peraeopod 6, coxal hind lobe very deep, sinuous, acute apex nearly attaining lower margin of basis; basis slightly broader than in peraeopod 5, inner face with a single plumose seta, (xii) peraeopod 7, basis with several proximo-medial plumose setae; hind margin straight throughout, shallowly crenulated, deeply posterodistally continuous with lower margin at almost a right angle, (xiii) uropod 3, rami relatively long and narrowly lanceolate, margins unarmed. unarmed.

HOST SPECIES: Unknown.

ETYMOLOGY: The species is named in honour of Anne Frame, fisheries biologist at Sandy Hook, New Jersey, who has contributed significantly to the knowledge of benthic amphipods in the North American Atlantic coastal region.

REMARKS: Although the host fish species is unknown, it probably frequents Canadian territorial waters. This record is the most southerly for the genus in North American Atlantic waters. This amphipod species illustrates some of the range of morphological diversity to be encountered within the genus.

Lafystius species

Lafystius sturionis Holmes 1905 (p. 492, figures of antennae, gnathopod 1, peraeopod 3, uropod 3, and telson

Holmes (1905) has briefly described and figured a male of several specimens collected from the mouth region of a goosefish (*Lophius americanus*) taken near Martha's Vineyard, Cape Cod, Massachusetts. There are many points of difference between these figures and those by Sars (1895) of European *L. sturionis* from cod (*Gadus*). Holmes' material was unavailable for re-examination; however, his work is deemed sufficiently accurate and complete to leave little doubt that his species is distinct not only from *L. sturionis* Kr., but also from the three other species of *Lafystius* from North American Atlantic waters newly described herein. Formal species designation, however, must await redescription and refiguring of Holmes' material, or description of fresh (preferably topotype) material from which holotype and allotype specimens may be selected. Such material could not be obtained before completion of the present study, nor were further specimens found on preserved museum specimens of goosefish available to the author.

DIAGNOSIS (from Holmes' figures and description): (Male 6.0 mm) Head short, broad; rostrum broad, obtuse; eyes rather small, nearly round, and containing few facets. Antenna 1 slightly longer and much stouter than antenna 2; peduncular segments of nearly equal length, segment 2 slightly the shortest; flagellum often shorter than the peduncle, with 6–7 segments, each furnished with "olfactory clubs" (aesthetascs), appearing in rows of 4–5, 4–5 rows on the first (conjoint) segment. Antenna 2 weak, peduncle not much thicker than flagellum, the latter composed of five or six elongate segments.

Mouthparts: Holmes did not describe the upper and lower lips, mandibles, or maxillae. Maxilliped, inner plate very narrow, inner margin with 2–3 setae, apex with a few large setae; outer plate large, (inner distal margin) pectinate, and armed with a few large setae; palp small, 2-segmented, not reaching tip of outer plate.

Peraeon segments 1 and 2 shorter than the others, their coxal plates small. Gnathopod 1, basis (apparently) with distinct bend in middle region; propodus slender, slightly longer than carpus or dactyl, illustration showing 5 anterodistal setae but no posterodistal setae; dactyl nearly straight. Gnathopod 2 short; propod, posterodistal angle of palm produced, rounded; dactyl tip bifid.

Peraeopods well developed and "of not very unequal length" (Holmes, p. 492); segment 6 (propodus in all) large and stout; dactyl large, smooth, hook-like. Peraeopod 3, propod stouter, and dactyl larger and more curved than in peraeopods 4–7. Peraeopods 3 and 4, segment 4 (merus) dilated and produced downward anterodistally.

Uropods 1–3, (peduncular and ramal margins) armed with very few spines; rami narrow, nearly equal to peduncle in uropod 1, a little longer than peduncle in uropod 2, and very much longer than peduncle in uropod 3. Uropod 3, outer ramus about three-quarters length of inner ramus, outer margins with 1–2 small spines. Telson appearing rectangular, slightly longer than wide, apex nearly truncate.

Female: Not described.

Host Species: Monkfish (*Lophius americanus* Valenciennes).

Remarks: Owing to the widespread occurrence of the host fish species from the northern Gulf of St. Lawrence, Grand Banks, and outer coast of Nova Scotia to the Bay of Fundy (see Leim and Scott 1966, p. 422), this species of *Lafystius* is likely to be encountered widely in the Canadian Atlantic region.

Paralafystius, new genus

Diagnosis: Generally similar to *Lafystius* in body form, slender urosome, deep pleosome plates, truncated rostrum and broad head, posteriorly setose propod of gnathopod 1, and peraeopods 5–7 with unlike bases and normal segment 5, but differing mainly in the following: (i) rostrum relatively short, less than half length of head, (ii) eye rounded, small, (iii) antenna 1, peduncular segment 1 shorter than 2, (iv) upper lip broadly rounded below, (v) mandible, left lacinia with 5 teeth, (vi) maxilla 1, outer plate short, inner group of apical spines vestigial, palp apically 1-segmented, (vii) maxilla 2, plates with few apical setae, (viii) maxilliped, inner plate short, palp 1-segmented, (ix) coxa 1 much smaller than coxa 2; coxae 2–4 broader than deep, (x) gnathopod 2, propod deep, palm convex, hind margin and posterodistal angle armed with short spines; dactyl not microcheliform at tip, unguis attenuated, (xi) peraeopods 3 and 4 (especially segment 6) conspicuously more powerfully prehensile than peraeopods 5–7; segment 4 very short, deeper than long, (xii) peraeopods 5 and 6, hind lobe of coxae rounded (not attenuated) below; bases lacking inner facial plumose setae; segment 6, anterior margin spinose, (xiii) pleopods relatively short, rami 6–8-segmented; "clothespin" spines present, tips bifid, (xiv) uropods 1 and 2 rami each with a prominent apical spine, (xv) telson subtruncate behind, (xvi) coxal gills 2–4 and 6 relatively short, sac-like, (xvii) brood plates large, marginal setae elongate.

Type species: *Paralafystius mcallisteri*, new species.

Remarks: The genus is closely similar to *Lafystius*, but more remote from *Protolafystius* in the characters noted in the key and above. *Paralafystius* is in general more advanced than the other two genera, especially in the reduced maxillae, 1-segmented maxilliped palp, reduced pleopods, and the more greatly enlarged and prehensile anterior peraeopods.

Paralafystius mcallisteri, new species
(Figure 9)

MATERIAL EXAMINED: Cross Sound, southeast Alaska near Elfin Cove, Stn A-56 (Map stn 69, Bousfield and McAllister 1962), 27–64 m, from skin of a fish specimen (see "Remarks"), 18.06.61, HOLOTYPE ovigerous ♀ (4.0 mm) (NMNS Cat. No. NMC-C-1986-1000).

DIAGNOSIS: With the characters of the genus. Eye weakly pigmented, about 25 facets. Antenna 1, flagellum 7-segmented, proximal aesthetascs elongate, in groups of 2–4. Antenna 2, flagellum slender, sparsely setose, 7-segmented.

Mandibular palp, segment 2 with single distal seta; segment 3, inner posterior margin with about 8 short, split-tipped setae.

Coxa 4 with short median process on lower margin. Peraeopods 3 and 4, hind margin of segment 6 with widely spaced weak setules.

Uropod 2, outer ramus lacking marginal spines. Uropod 3, inner ramus bare.
Male unknown.

HOST SPECIES: Uncertain, but specimens of the following fish species were taken with the amphipod at Stn A-56: *Sebastes melanops*, *Hexagrammos decagrammus*, *Hemilepidotus hemilepidotus*, *H. jordani*, and *Bathymaster signatus*. No other amphipod parasites were encountered at this station.

Protolafystius, new genus

DIAGNOSIS: Body relatively long and slender, little broadened. Head not elevated anteriorly; not broader than long, anterior lobe sub-acute, antero-lateral margin incised; rostrum apically rounded. Eye small, elliptical.

Antennae subequal in length; flagella short, 5–6 segmented.

Upper lip weakly incised below, slightly asymmetrical. Mandible, left lacinia with 4 teeth, right lacinia a simple spike: palp segment 3 arched, posterior margin with slender spines. Maxilla 1, inner plate narrowing, with 2 apical setae; outer plate narrowing, apex continuous with inner margin, with 7 strong distal and 4 small proximal spines. Maxilla 2, inner plate narrowing distally. Maxilliped, palp 2-segmented, inner plate elongate.

Gnathopod 1, propod lacking posterodistal setae. Gnathopod 2, palm short, posterodistally right-angled, inner face and hind margin setose; dactyl unguis short, spine-like, forming microchela with posterodistal process. Coxae 1 and 2 small, subequally deep, 3 longer, subrectangular, 4 very large, broadly acuminate below. Coxae 5 and 6, hind lobes broadly deepened below (not sharply produced). Peraeopods 3 and 4, and 5–7 moderately and similarly prehensile. In peraeopods 3 and 4, margins of segments 4 and 5 bare, 4 strongly overhanging 5 anterodistally. Peraeopods 5–7 closely similar in form and size; bases broad, rounded behind, weakly setose medially, segment 5 distinctly shorter than 4, 4 strongly overhanging 5 posterodistally, segment 6 spinose anteriorly.

Pleosome side plates normal, about as wide as deep. Pleopods strong, rami multi-segmented. Urosome segment 1 normal, not elongated; uropod 1 peduncle about equal to rami. Uropod 3, inner ramus, margins weakly spinose. Telson shallowly and broadly incised apically.

Coxal gills relatively large; elongate sac-like on peraeopods 2–4, plate-like on peraeopods 5 and 6, small on peraeopod 7.

Brood plates 2–4 broad, 5 sublinear; setae elongate.

Type species: *Protolafystius madillae*, new species.

Other Species: "*Lafystius sturionis*" Jensen et al. (1982).

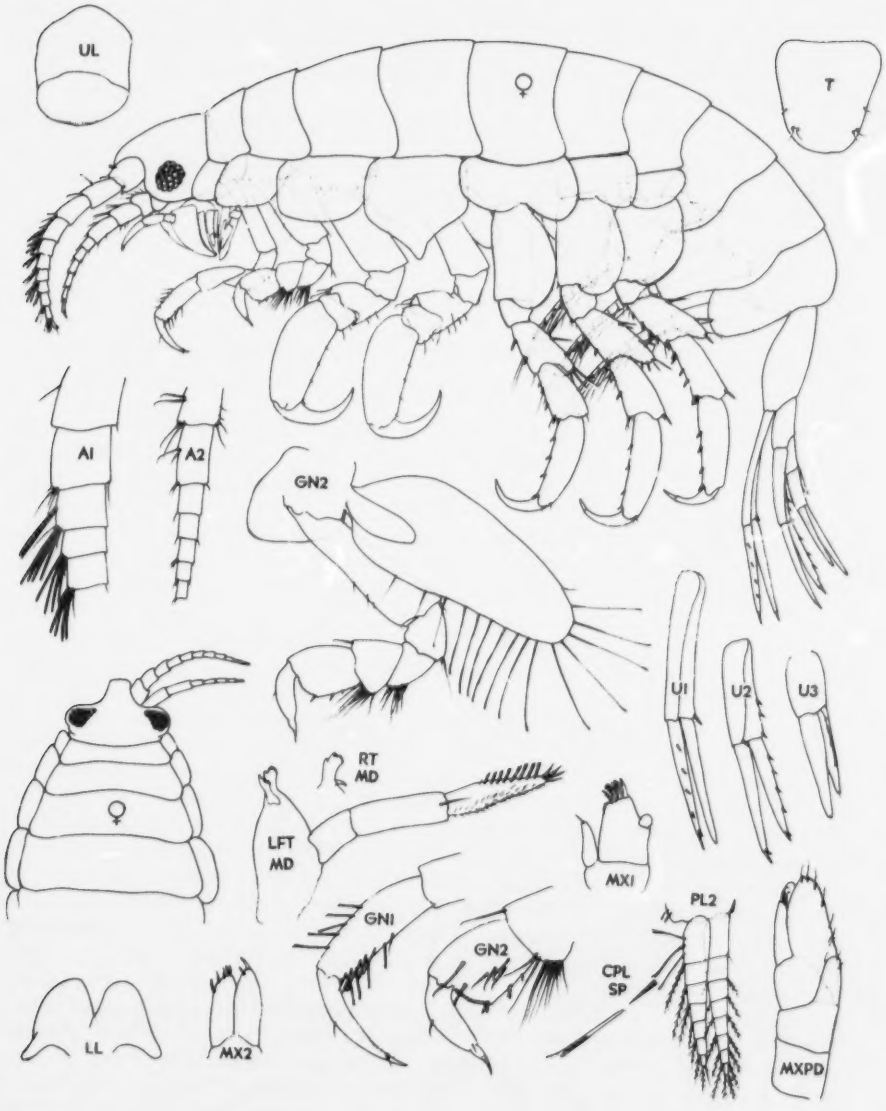

FIG. 9. *Paralafystius mcallisteri*, n. g., n. sp. Cross Sound, S.E. Alaska, Stn. A56, 1961. On greenling cod — ♀ ov. 4.0 mm. (*See p. 37 for legend for figures.*)

REMARKS: The genus is relatively plesiomorphic in overall characters of body, head, and appendages. It is remote taxonomically from *Lafystius* and, even more so, from *Paralafystius*. In mouthpart structure, however, the plates, especially of the maxilla, and the mandibular incisor are relatively long and attenuated, forming a more deeply conical, presumable more effectively piercing, buccal organ, as in other members of the family.

Protolafystius madillae, new species
(Figure 10)

MATERIAL EXAMINED: White Rocks, Hecate Strait, B.C., Haul #12 (53°41′48″N,130°-47′24″W), 81 m, on gills of English sole (*Parophrys vetulus* Girard), 12.06.83 (J. Madill, coll.), HOLOTYPE ovigerous female (5.0 mm) (NMNS Cat. No. NMC-C-1986-1001).

DIAGNOSIS: With the characters of the genus and: Eye partly masked behind by coxa 1, about 50 pigmented facets. Antenna 1, proximal (conjoint) flagellar segment with three groups of aesthetascs, 2–3 per group. Antenna 2, peduncular segment 4 very short, little longer than 3.

Mandibular palp, posterior margin of segment 3 with 7 slender, weakly pectinate spines, and 3 apical spines; left incisor 5-cuspate. Maxilliped, inner plate apically subacute, with 2 setae; outer plate margins subparallel, apex broadly rounded, inner distal margin crenulated; palp, distal segment slender, longer than proximal.

Gnathopod 1, dactyl nearly straight, nearly as long as propod. Gnathopod 2, dactyl unequally microchelate at tip. Peraeopod 4, anterior margin of segment 5 nearly totally overhung by distal process of segment 4. Peraeopods 5–7, anterior margin of segment 4 nearly bare; hind lobes of coxae 5 and 6 less than half as deep as corresponding basis.

Abdominal side plates, hind corners rounded, lower margins smooth. Pleopod rami 12–15-segmented, about as long as peduncles. Uropod 1, peduncle with about 10 short outer marginal spines; inner ramus with 3–4 marginal spines on each side. Uropod 3, rami with a few short but distinct spines on inner margins only.

Brood plate on peraeopod 4 large, broad, anterior margin with 20–25 simple setae increasing in length distally. Brood plate 5 nearly linear, short, with 10–12 very long marginal setae throughout.
Male unknown.

HOST SPECIES: English sole (*Parophrys vetulus*), on gills.

ETYMOLOGY: The species is named in honour of Jacqueline Madill, Natl. Mus. Nat. Sci. colleague, whose pioneering studies on marine fish leeches resulted in the collection of this remarkable new amphipod parasite.

The record of "*Lafystius sturionis*" from *Sebastes paucispinis* in coastal waters of California (Jensen et al. 1982) refers to a new species of this genus (Bousfield, unpublished data, material courtesy Brad Myers, Santa Ana, CA, and R. Lichtenfels, Washington, DC.) A third, apparently new, species has been taken freely (without host) from the California coast by Brad Myers (Bousfield, unpublished data).

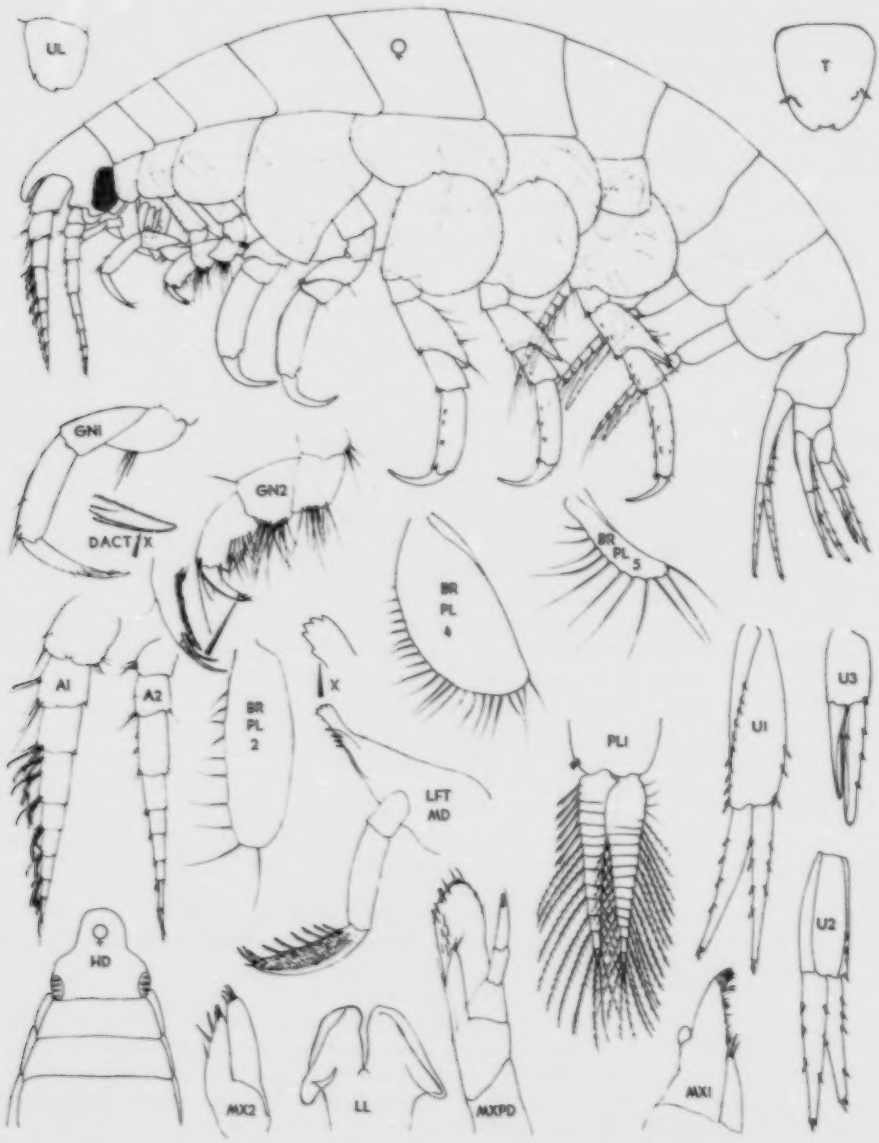

FIG. 10. *Protolafystius madillae*, n. sp. Hecate Strait, Q.C.I., B.C. From gills of English sole — ♀ ov. 5.0 mm. (*See p. 37 for legend for figures.*)

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LEGEND FOR FIGURES

A1	antenna 1	MX2	maxilla 2
A2	antenna 2	MXPD	maxilliped
BR PL	brood plate	P	peraeopod
CALC	calceolus	PENULT	penultimate stage
CLPN SP	clothespin spine(s)	PL	pleopod
CP SP	coupling spine(s) (retinacula)	PLP	palp
CX	coxal plate	RT	right
DACT	dactyl	SET	seta(e)
GN1	gnathopod 1	T	telson
GN2	gnathopod 2	U	uropod
HD	head	UL	upper lip
LFT	left	UROS	urosome
LL	lower lip	X	magnified
MD	mandible	♂	male
MX1	maxilla 1	♀	female